Concrete Suggestions for the Farm

Fall and Winter 1924

LEHIGH
CEMENT

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CONCRETE SUGGESTIONS *for* THE FARM

Fall and Winter—1924

INFORMATION FOR
THOSE INTERESTED
IN IMPROVEMENTS
that are PERMANENT

LEHIGH
CEMENT

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CEMENT COMPANY

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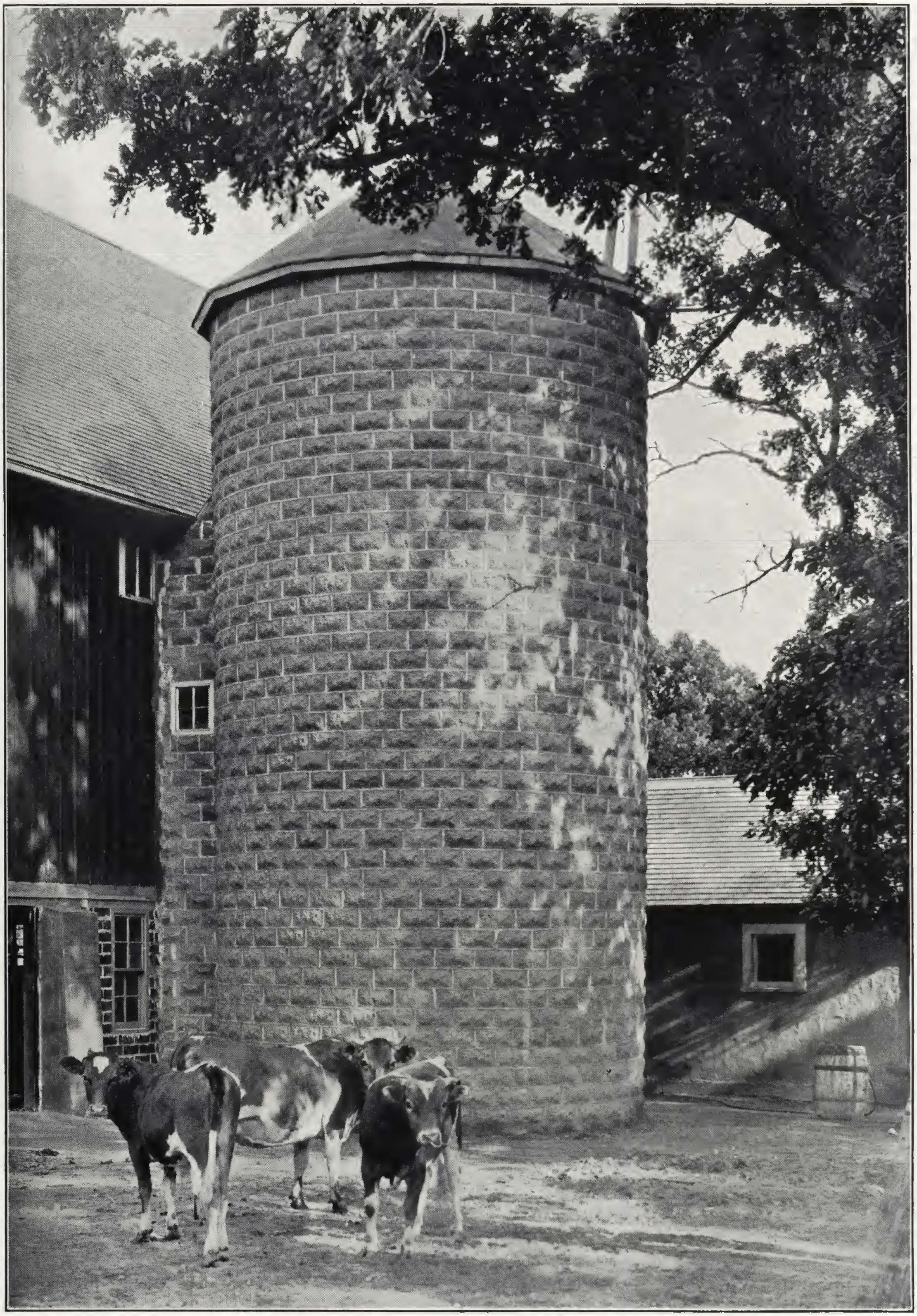

September 5, 1924

Dear Dad:

By this time I guess you'll have completed the harvest work and I know you will be glad of it. Things look pretty prosperous this fall, don't they?

I've had a bully time with Uncle John and Aunt Mary and in the ten years since you were here last they certainly have slicked things up. The big crops and good prices Uncle John received this Fall will start him on more work again, I know.

You know it is quite a step from the barn to the house. Uncle John put a concrete walk down last winter and Aunt Mary is tickled to death and said this was the first Spring the house was fit to live in.

You should see the big storage space the folks have in their two new concrete silos. Uncle John says the lightning can't touch them.

I helped him last week put in a concrete watering trough and it was an easy job and I'll see that we have one this Fall, as I can easily do it myself.

The Dairy Inspector was here last week and almost insisted on a concrete barn-yard and manure pit. You remember we talked that over last winter and you said you would do something about it.

I guess you'll think I can only talk concrete, but really dad, concrete can't be beaten any way

(over)

you look at it. No fear of fire, no painting every year or two, no rotting of timbers and constant repairing, but solid as a rock year after year.

Last week I was down at the bank with Uncle John when he paid off a note and the cashier told him he could have more, anytime he wanted it and Uncle thought it was because the place has real value since he fixed it up.

If you think I am overdrawing things, just run down and see for yourself.

The hogs have regular concrete swimming pools, (hog wallows, of course), the fence posts are of concrete, once up they give you no further trouble, – Uncle made them last winter when the work was slack – every farm along the river has a concrete ice house, some have corn cribs of concrete, and the foundations of all chicken houses are of this material.

I asked Uncle John if he found it expensive and he said no, particularly when you consider the saving made over a period of years.

I am coming home next week. Meet me at the station on the 5.10 Thursday.

Give my love to mother and the rest.

Ed

P. S. If you should decide to do any concreting before I get home, be sure to buy "Lehigh." It is really a good portland cement, and you can locate the dealer by the blue-and-white Lehigh sign. He can also give you good information on how to do the work.

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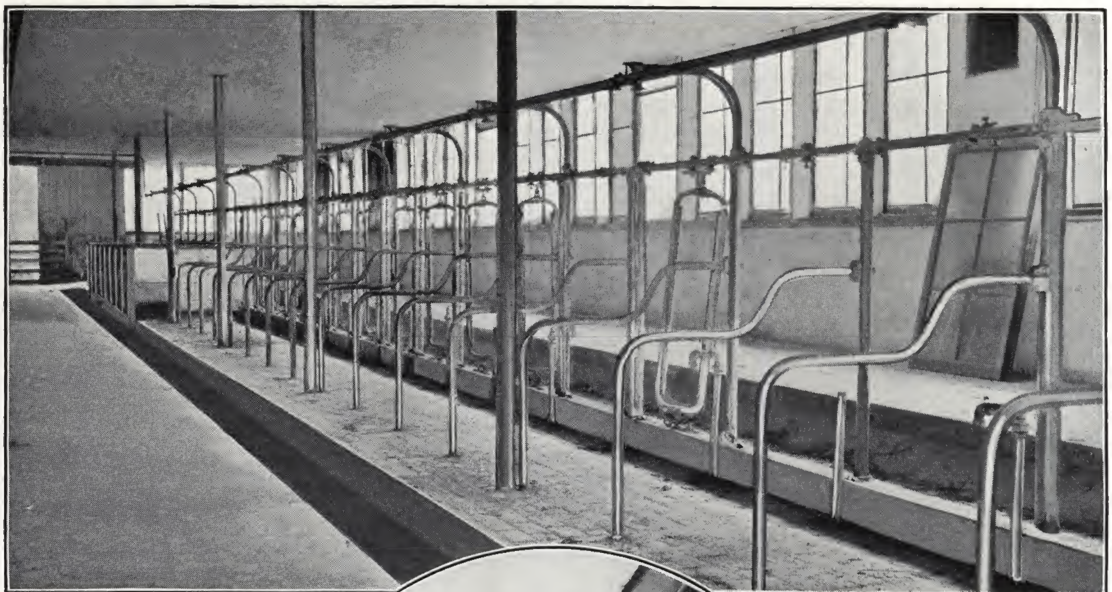
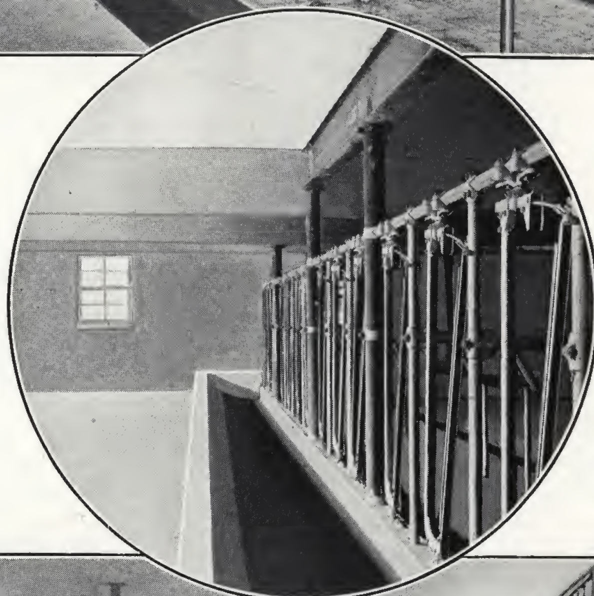




Concrete Barns

THE central structure of every farm is the barn. Whether for dairy cattle, to house live stock, or a general purpose barn, its importance among the farm structures warrants careful planning and the very best construction. A concrete barn is safe against fire, wind, and storms. It stands as a protection against a total loss of the harvest, and the destruction of the dairy herd or other live stock.

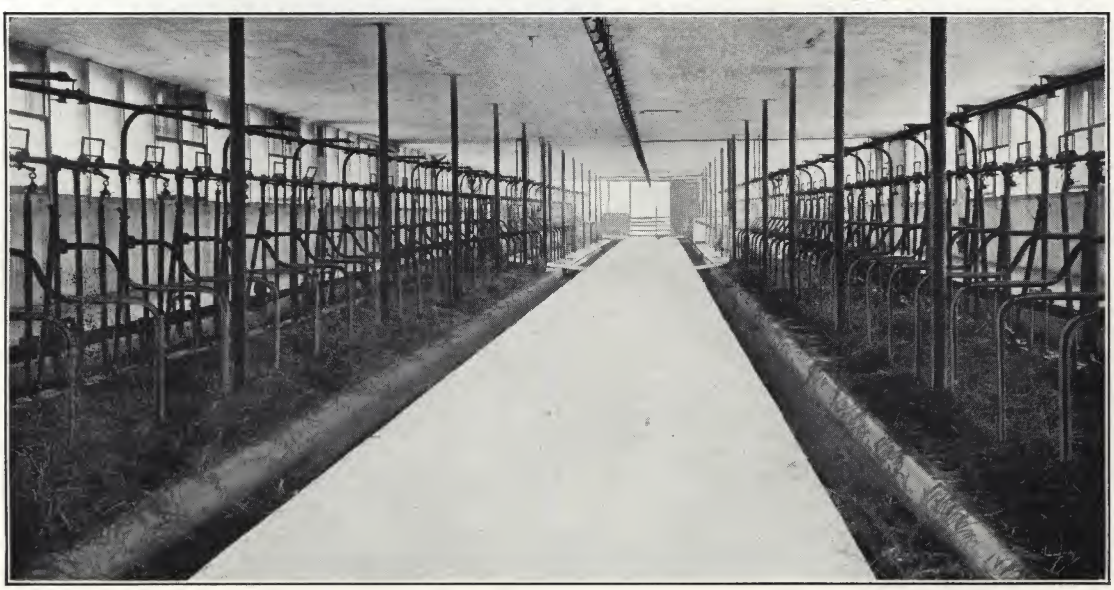
Concrete construction keeps out rats. It reduces the labor necessary to operate a farm, and makes possible a building of convenience and beauty. Beyond all, it is permanent; it requires no replacement.

A well built and well arranged barn lowers the cost of feeding and caring for stock. Feed storage bins should be conveniently located. Alleyways should be wide enough to accommodate a silage cart, feed carrier and litter carrier. Silos should be located so that they will not interfere with future extensions of the barn.

Concrete provides a solid foundation, water-tight and rat-proof, moderate in cost, and easily constructed. Foundations should extend below the ground level to good firm soil, below possible disturbance from upheaval due to frost. A footing two feet in width and one foot thick is generally sufficient.

Both monolithic (solid) concrete and concrete blocks are practical for the construction of barn walls. Such walls are highly sanitary, and are easily washed and disinfected when necessary. They will not rot, and require neither paint nor repairs.

One of the most important details in sanitary barn construction is the floor. Considerable choice may be exercised in the arrange-



ment of the dairy barn floor. Stock may face in or out.

A concrete stablefloor will be sanitary, easy to clean, comfortable for the stock, and durable. It can be used for the entire construction, with cork brick or wood block for the floor of the stalls for warmth and ease on the feet of the cattle.

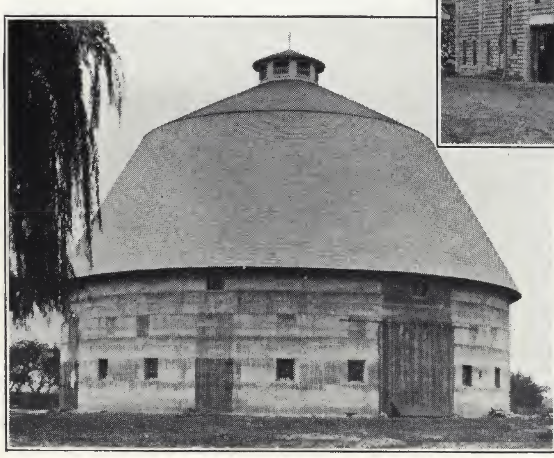
Floors should have a slope of about one inch between the manger and the gutter, in order that the floor can be quickly flushed and drained into the manure gutter.

Gutters are made from 16 to 18 inches wide, so they can readily be cleaned with an ordinary shovel. They should slope $\frac{1}{16}$ inch per foot to a tile drain.

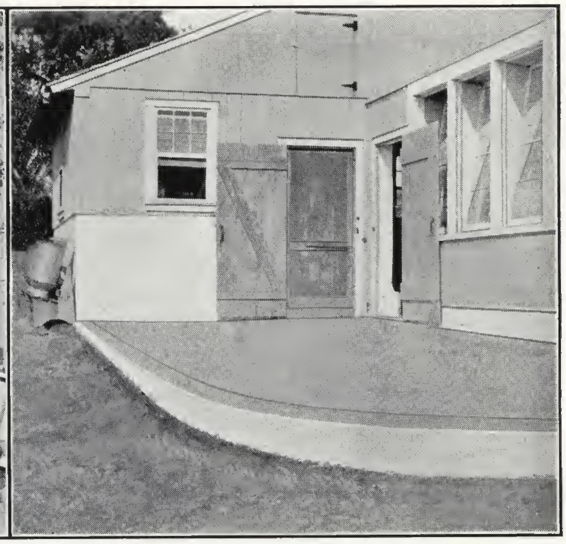
One-course construction is recommended for stablefloors. The usual thickness of a concrete floor is four to five inches. A 1:2:3 mix (one part cement, two parts sand, and three parts gravel or stone) will produce a water-tight floor and prevent seepage of soil moisture. The floor should be finished with a wood float, to secure an even but gritty surface, thus providing secure footing.

Where the investment for an all-concrete barn is prohibitive, many farmers have built the footings, walls, and the first floors of concrete, replacing from time to time the different units of the wooden superstructure until they have attained the complete concrete building.

Concrete can be used for the construction of barns of all types and sizes



A well-planned and equipped barn saves time and labor for the farmer, and provides comfortable quarters for the stock. It is important to study the best principles of barn construction and the most satisfactory types of equipment before building or remodeling a barn

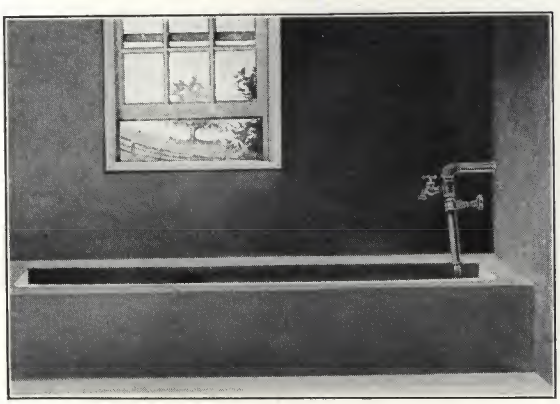


Dairy and Ice Houses

MODERN dairying demands concrete construction in the dairy house. Sanitation and cleanliness are essential, and concrete is the only material which will enable the dairyman to meet these requirements. Not only does it promote cleanliness, but it will in addition withstand the moisture typical of the average dairy house.

Milk should not be handled in the kitchen, wash room, or work shop. As soon as drawn, the milk should be removed to a clean place and cooled within an hour to as near 60 degrees as is practicable with the facilities available.

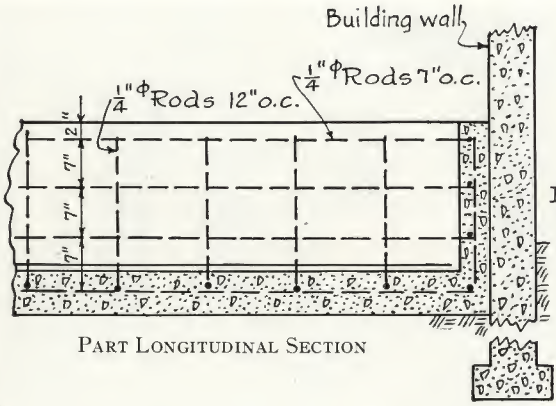
All milk producing farms should be provided with a conveniently located dairy house or spring house. It should be free from contaminating surroundings, screened against flies and other insects, and be provided with a smooth concrete floor. The dairy house should be easy of access from the farm house, the barn, and the ice house. There should be no direct communication from the milk house to the stable. The site should be one insuring good soil drainage, and some natural shade is an advantage in summer, although the sterilizing effect of sunlight should not be overlooked.



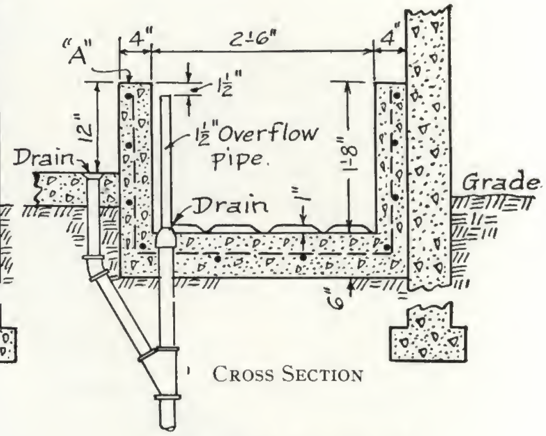
Good circulation of air is necessary, and should not be left entirely to chance or occasional opening of doors and windows. A metal ventilator built in the roof, with suitable inlets, will provide thorough circulation.

Particular care should be used in constructing the milk house floor. Concrete is by far the best material for this purpose, as it resists moisture, decay and wear. This floor should be of one-course construction, four or five inches thick. A 1:2:3 mix (one part cement, two parts sand, and three parts gravel or stone) will produce a satisfactory and watertight floor. The floor should be sloped to a drain, and the surface troweled hard and smooth.

Every farmer should maintain in his dairy house an approved method of cooling his milk, and a sanitary cooling tank is an essential part of the dairy house equipment. This tank can be built in the same manner as a stock watering trough. Inlet and overflow fittings should be provided. Grooves cast in the bottom of the tank while the floor is being concreted will provide for adequate circulation of water under the cans. This



Part Longitudinal Section



Cross Section

MILK COOLING VAT

Assume 6′ 0″ long. 1 : 2 : 3 Mix

Walls	= 6.6 cu. ft.
End walls	= 2.8 cu. ft.
Bottom	= 9.5 cu. ft.
	18.9 cu. ft. or .70 cu. yd.

Material Required

Lehigh cement	= 1.2 bbls.
Sand	= .36 cu. yd.
Pebbles	= .54 cu. yd.

Reinforcement

143 lin. feet of ¼″ round rods or 24.5 lbs.

groove can be formed by pressing several triangular strips of wood into the concrete before it has hardened and afterward removing them.

Frequently an ice house and milk room are combined. With a supply of ice available, the contents of the tank can easily be kept cool. Otherwise, spring water may be circulated through the tank.

Concrete Ice Houses

Ice houses are subjected to continual dampness. The rot-proof qualities of concrete provide construction that is not affected by this condition. Concrete blocks are particularly suited to concrete ice house construction because of the air spaces introduced in the walls, which provide sufficient insulation to reduce meltage of ice to a minimum, regardless of outside temperature conditions. The concrete floor in an ice house should have a drain to carry away the water. This drain should be trapped to seal it against entrance of warm air.

When monolithic concrete is used for an ice house, double wall construction is sometimes used to provide insulation in the wall, or a veneer of hollow tile is laid on the inside for the same purpose. The concrete roof is insulated by laying two slabs separated from each other by a layer of clean cinders.

Ice house walls, both monolithic and block, must be reinforced in a manner similar to the reinforcing of silos, to enable them to withstand any pressure which might be caused by the shifting of the ice.

A watering trough with a paved area around it

Watering Troughs

THE importance of the watering trough and the simplicity with which it can be built make it one of the first pieces of concrete work to be done on the farm. Water-tightness is the prime essential of any structure intended to hold liquid. In making concrete for watering troughs, the materials should be carefully selected, and care should be exercised in securing the proper proportions and in placing the concrete. It is easier to make concrete water-tight at the time of construction than it is to make leaky concrete water-tight after the work has been completed. Square or oblong tanks of various kinds are easier for the home worker to build because the forms may be constructed without difficulty.

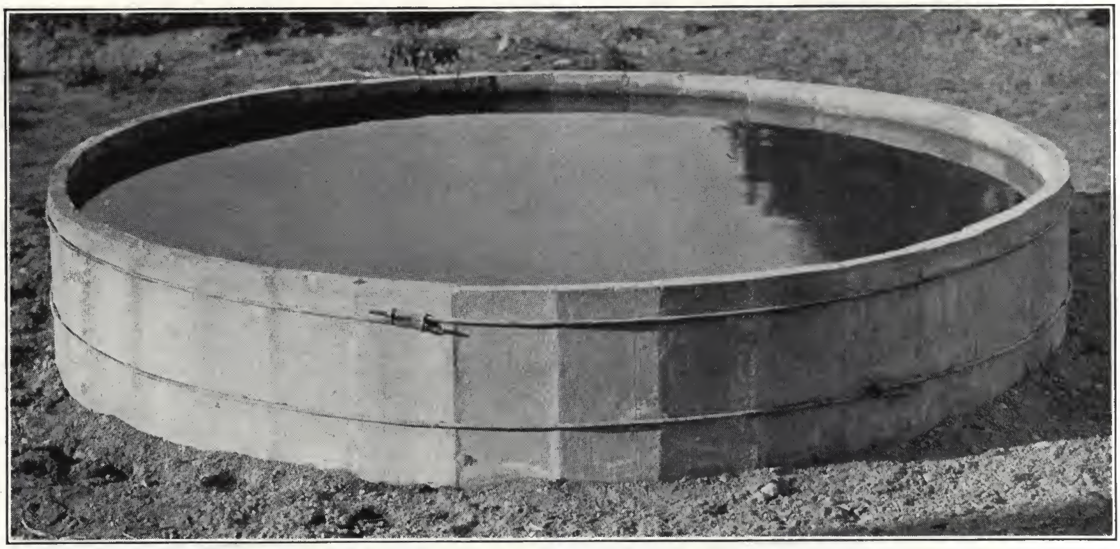
When building a trough or tank, concreting should be continuous until the work is completed. This is the surest way to prevent construction seams that might cause leakage.

For small troughs and tanks, such as are used for watering cattle in the barnyard or pasture lot, it is necessary to provide against the pressure of ice by sloping or battering the inside wall of the tank to relieve some of the pressure and avoid injuring the tank.

A 1:2:3 concrete mixture (one part cement, two parts sand, and three parts gravel or stone) is recommended, and should be mixed to a jelly-like consistency. Spading between forms and against form faces must be thorough in order to produce a dense concrete. Only in this way can water-tightness be actually assured. Forms should not be removed until several days after the concrete has been placed, and during this time the concrete

A small drinking trough which can be made by any one handy with tools

A concrete trough in the pasture insures a supply of clean water



A circular trough made with concrete staves

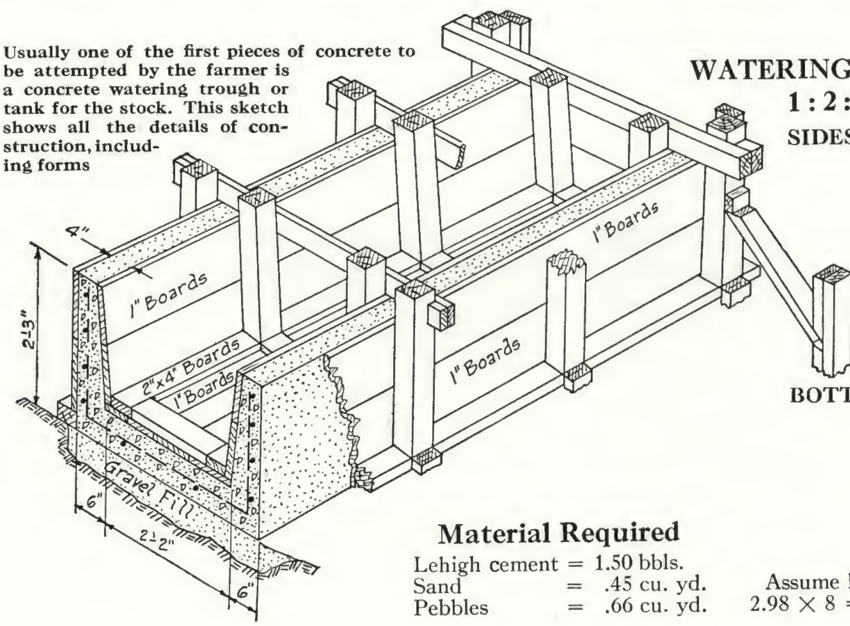
should be kept covered with wet hay or straw to keep the concrete from drying out. Failure to spade the concrete thoroughly may result in irregularities in the finished surface. If this condition is found when the forms are removed, patching should be done with a cement mortar consisting of one part cement and two parts sand.

The pressure exerted by the water makes it necessary to reinforce all watering troughs. The amount of reinforcing and the method of applying it will vary with each trough. Both vertical and horizontal reinforcement is required. Corner rods should be provided. In the construction of small tanks, mesh fabric may be used instead of steel rods.

Provision must be made for water inlet and outlet at the time forms are set. An outlet is as necessary as an inlet, because tanks must be cleaned occasionally, and the easiest way to flush them is through an outlet provided for that purpose. By using a double valve connection, the inlet and outlet can be combined into one fitting, which may be built into the floor when the first concrete is placed.

To avoid the unsanitary mud hole adjacent to the trough a small section of paving around the tank should be provided.

Usually one of the first pieces of concrete to be attempted by the farmer is a concrete watering trough or tank for the stock. This sketch shows all the details of construction, including forms



WATERING TROUGH
1 : 2 : 3 Mix

SIDES

2.25
.42
———
450
900
———
.9450
2
———
1.8900 sq. ft.

BOTTOM

2.17
.5
———
1.085 sq. ft.

1.89 sq. ft.
1.09 sq. ft.
———
2.98 sq. ft. in cross-section

Assume length of 8 feet for trough:
2.98 × 8 = 23.84 cu. ft. or .86 cu. yd.

Material Required

Lehigh cement	=	1.50 bbls.
Sand	=	.45 cu. yd.
Pebbles	=	.66 cu. yd.

A covered concrete manure pit

Manure Pits

A MANURE pit is a form of tank. It should be tight enough to hold the liquid content of the manure, which is the most valuable part. It is also desirable that the pit be roofed over to prevent excessive rains from keeping the manure so wet that its decomposition cannot be properly controlled.

Manure pits vary in design and construction. They may be built so that the top of the side wall is level with the ground, or built with the floor almost at the ground level and the side wall two or three feet above it. In the latter case the pit generally has an opening at one end, in order that wagons can back into it for convenience in loading.

If any considerable quantity of manure is to be stored for an unusual length of time, the pit should have a cistern at one end into which excess liquid can drain, and from which it can be pumped at intervals.

Ordinarily the floor of a concrete manure pit requires no reinforcement. The side walls must be reinforced to take care of earth pressure or the pressure of manure in the pit.

The joint between wall and floor should be sealed with hot tar to prevent leakage.

The capacity of a pit should be determined by the number of animals kept. A pit 24 by 20 feet is large enough to accommodate the stable waste from about 15 cows.

The pit should be located so that it is directly in line with the cleaning alley in the barn, thus making a straight run for the litter carrier.

A 1:2½:5 mix (one part of cement, two and one-half parts of sand, and five parts of gravel or stone) is recommended for the floor and walls of a manure pit. To secure a water-tight cistern to hold the liquid content of the manure, a 1:2:3 mix is necessary.

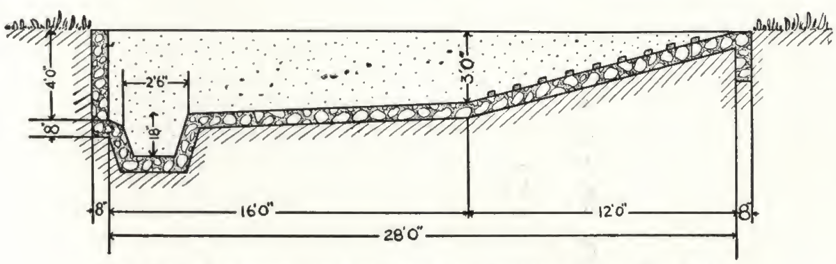
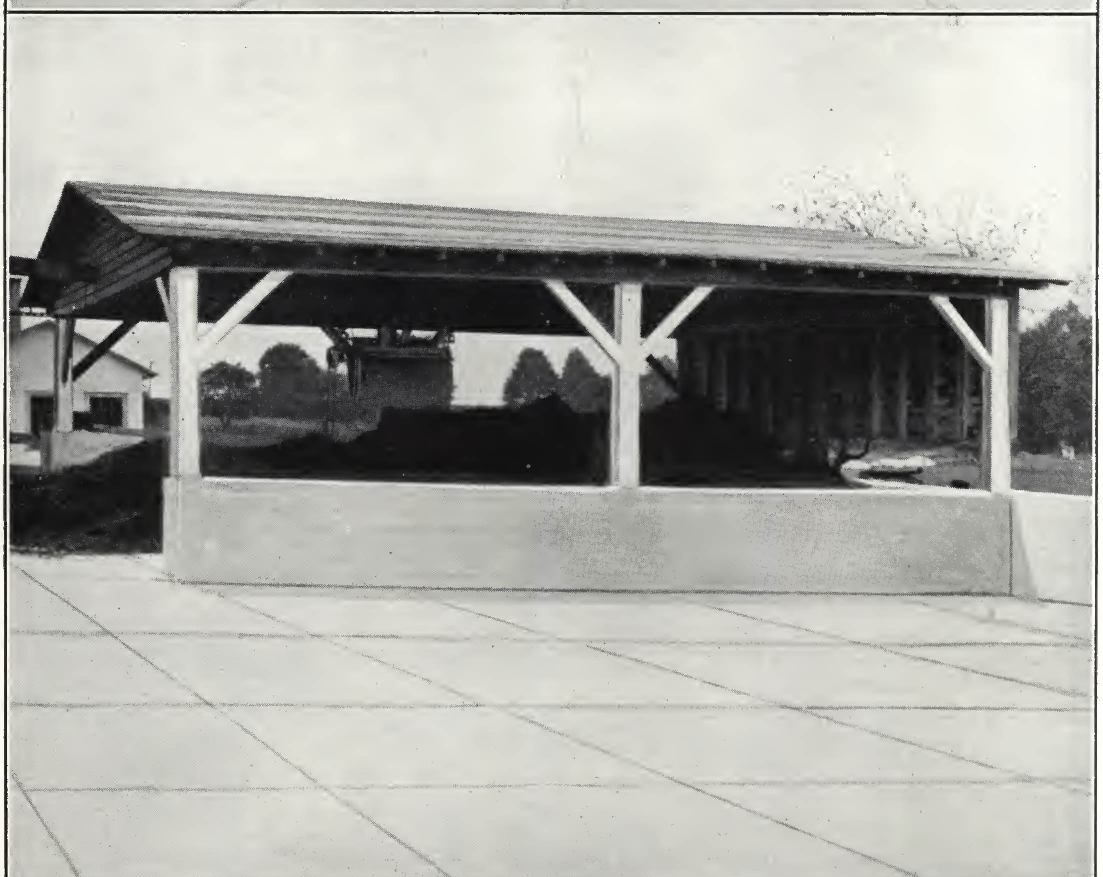
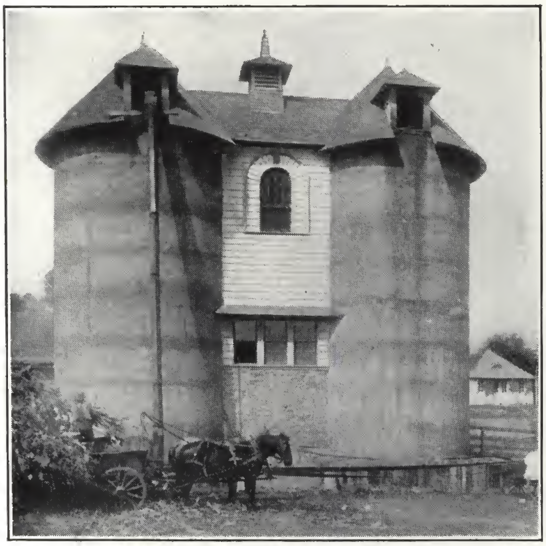


Diagram of manure pit with cleats to provide foothold for horses





Concrete Silos

SILOS must be air-tight, water-tight, strong, durable, and have smooth interior walls. They must be permanent and require little or no maintenance. If the proper method of construction has been followed, the silo will be fire-proof. No quality is more desirable than fire-proofness when it is considered that the silo usually contains a season's crop of feed.

The silo should be located where it will serve the greatest convenience in feeding operations, and is usually connected to the barn by a short covered passageway.

Monolithic Construction

Silos may be made of monolithic concrete, concrete blocks or concrete staves. For monolithic construction, special circular steel forms should be secured, because the cost for material and labor for making wood forms is seldom justified for a single structure. It is usually better to engage an experienced contractor who specializes in the building of silos to move his outfit to the farm and put up the structure.

In building monolithic silos only one complete ring per day can be cast on the structure. Under favorable conditions the concrete will have hardened sufficiently during a period of twenty-four hours to permit raising forms for the next day's concreting. This procedure is carried on until the structure is completed. In cold weather concrete does not harden rapidly, and forms should not be raised at the end of twenty-four hours unless the concrete has hardened sufficiently. Frozen concrete should not be mistaken for naturally hardened concrete.

The exterior of the silo can, if desired, be given a uniformly even appearance by applying a coat of cement and water paint after concreting has been completed. This can also be applied to the interior wall face, and will aid in sealing the pores and irregularities in the surface.

Fire-proofness is not secured in the fullest measure unless the structure is finished with a concrete roof.

When a silo has been filled with silage, the contents subject the walls to considerable pressure. This pressure is greatest at the bottom, particularly when there is considerable liquid in the silage. Therefore, more reinforcement must be used in the lower portion of the structure than nearer the top. Vertical reinforcement also is needed in all monolithic silos. This usually consists of 3/8- or 1/2-inch steel rods spaced 30 inches apart along a line corresponding to the center of the silo wall.

Block Silos

Concrete block silos are built of block molded in a special machine which gives them a slightly curved face. When laid in courses, they produce a circular structure.

A concrete block silo is essentially a masonry job, and it involves, among other things, well-bedded mortar joints in order that the

A concrete stave silo, like the block and monolithic structures, is wind-proof, rot-proof, and fire-proof

finished structure shall have the required water-tightness and leak-proof qualities necessary. It is, therefore, better to engage a local contractor to do the work.

Block silos must be reinforced. Horizontal hoops in the form of round rods can be imbedded partly in the mortar joints and partly in grooves cast when the block is made.

Intermittent doors with concrete doorframes are generally preferred for block silos. The interior of the block silo may be given a coat of cement grout, similar to that used on the monolithic silo.

Stave Silos

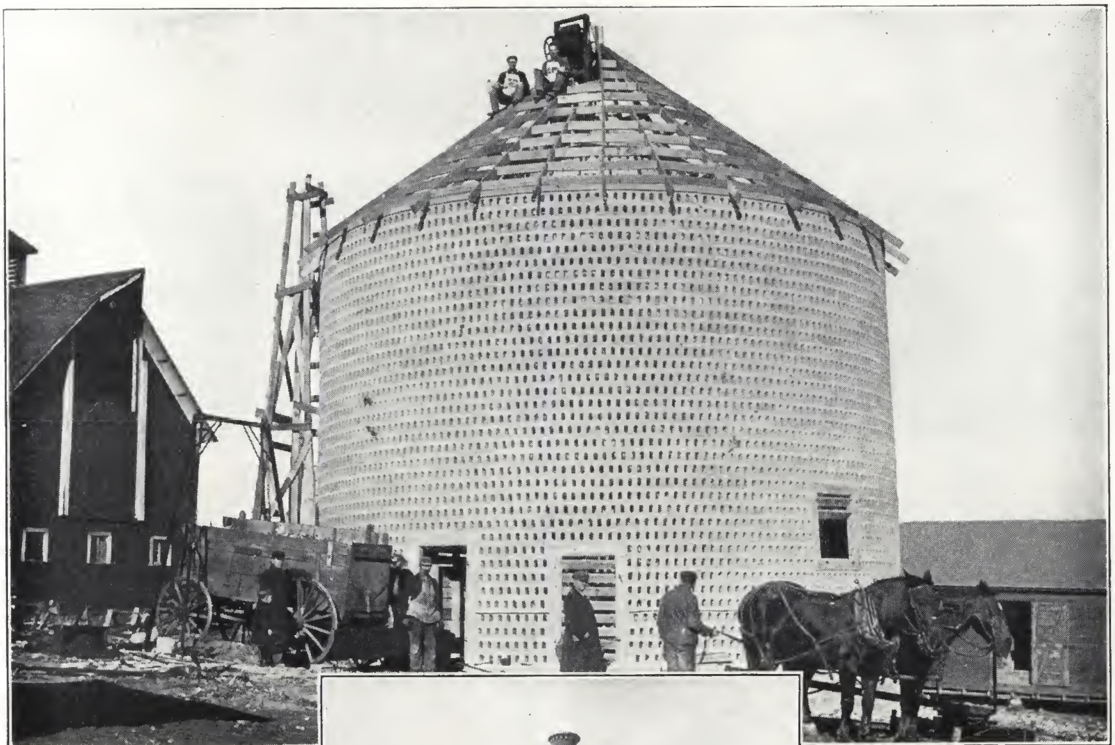
The concrete stave silo is also very popular. A concrete stave is a slab of concrete, generally from 2½ to 3 inches thick, 10 to 12 inches wide, and from 28 to 30 inches long. When used to lay up the wall, the staves are set on end and their edges interlock. An advantage of the concrete stave silo is the fact that it can be very quickly erected.

The concrete stave silo, like the block and monolithic structure, is wind-proof, rot-proof, and fire-proof, and possesses a degree of permanence found only in concrete construction. The principal difference between concrete stave silos and the other types of concrete silos lies in the manner in which reinforcement is applied. In the monolithic and block silos reinforcement is imbedded in the concrete. In the concrete stave silo it takes the form of hoops placed on the outside and tightened by means of turnbuckles.

As in the case of monolithic and block silos, it is recommended that an experienced contractor be engaged to erect a concrete stave silo.

APPROXIMATE CAPACITY OF ROUND SILOS

Height of Silo Feet	Inside Diameter of Silo in Feet and Capacity in Tons					
	10 Feet	12 Feet	14 Feet	16 Feet	18 Feet	20 Feet
	Tons	Tons	Tons	Tons	Tons	Tons
28	42	61	83	..	..	..
30	47	67	91	..	..	..
32	51	74	100	131	..	..
34	56	80	109	143	..	..
36	61	87	118	155	196	..
38	66	94	128	167	212	..
40	70	101	138	180	229	280
42	..	109	148	193	244	299
44	..	117	159	207	261	320
46	..	..	170	222	277	340
48	..	..	..	236	293	361
50	..	..	..	..	310	382



A typical concrete block corn crib

Construction details same as block silos

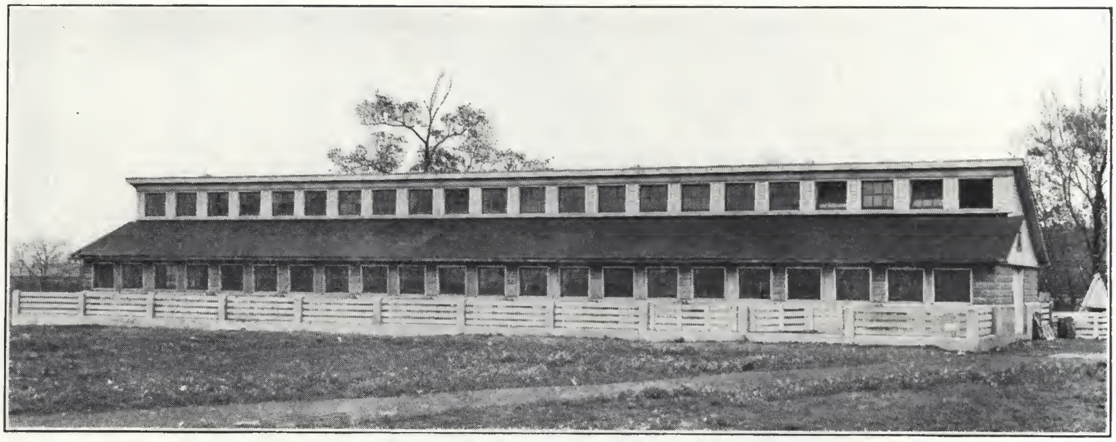
Corn Cribs

RATS destroy many dollars' worth of grain in storage each year. They can, however, be effectively built-out of corn cribs by the use of concrete. Concrete blocks similar to those used in concrete block silos are used, except that openings are cast into the block at the time it is made, to provide ventilation. These openings are made rat- and mouse-proof by imbedding wire mesh in the block when cast. Block corn cribs are usually built circular in form, and have at their center a flue or chimney connected with air inlets at the base, for ventilation. Another type of concrete corn crib is built of special concrete staves, also cast with openings to provide necessary ventilation.

Concrete corn cribs are generally built with metal roofs. All doors should be of metal or protected by metal covering, in order that rats cannot gnaw through.

Corn cribs should have concrete floors raised sufficiently above ground level to prevent dampness. Floors should slope uniformly in one direction, to drain off water that may blow through the openings during storms.

A 1:2:3 mix (one part cement, two parts sand, and three parts gravel or stone) is recommended for floors of corn cribs. This mixture will prevent seepage of the soil moisture.



The first consideration for profitable hog raising is sanitary quarters

Hog Houses and Wallows

PROFITS from hog raising are largely dependent on the housing provided. Sanitation is the prime essential. Clean and healthful quarters are absolutely necessary.

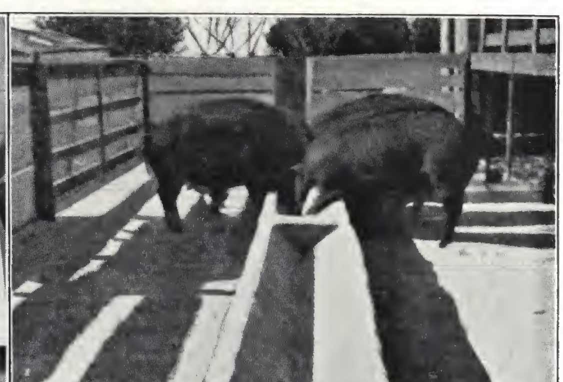
Without warm quarters, the young pigs cannot be expected to develop properly. They must be in the best condition for early marketing to bring maximum profits. This can be attained only with well-ventilated, dry pens designed to provide plenty of sunlight and built so that there will be no cracks or crevices in which filth might lodge. Concrete is the only material that will economically meet all these requirements.

A hog house should be located on a well-drained site. It should face south, unless it is of the double monitor type, in which case it should extend north and south, thus permitting one row of pens to get sunlight in the morning and the other in the afternoon. While concrete floors are not cold if the stock is sufficiently bedded, hogs are a little more difficult to provide for because of their tendency to disturb bedding placed for them. It is, therefore, best to build a removable slat floor in one corner, or at one side of each pen, for bedding quarters. If the hog house is of the monitor type, the passageway between the rows of pens should be wide enough to serve as a driveway, in which case the concrete floor must be constructed to withstand traffic.

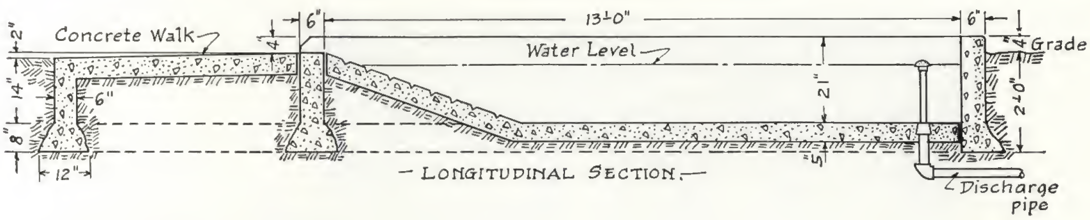
A concrete wallow is nothing but a tank of suitable size and depth to permit the animals to cool themselves in clean water. In addition, the tank may be made to serve dipping purposes by mixing germicidal solutions with the water. For hog wallows a 1:2:3 mix (one part cement, two parts sand, and three parts of gravel or stone) is recommended in order to obtain water-tightness.

A 1:2:3 mix is satisfactory for floors and foundations of a hog house.

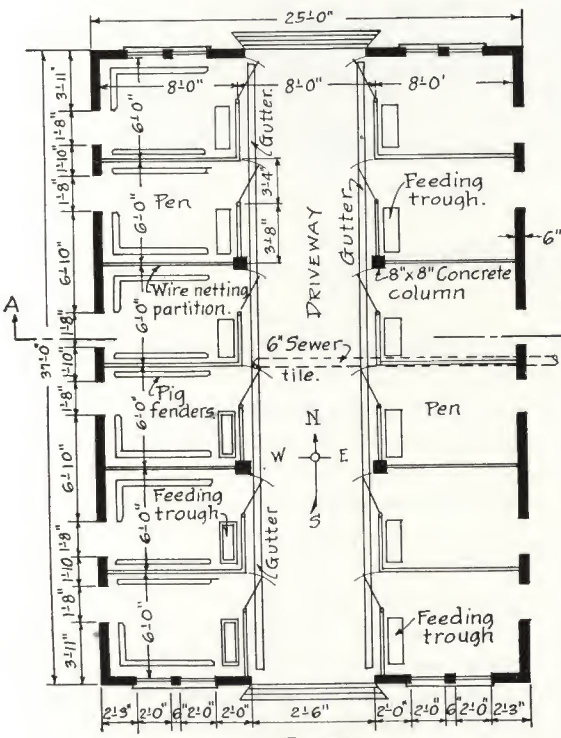
A concrete wallow is a tank of suitable size and depth to permit the animals to cool themselves in clean water



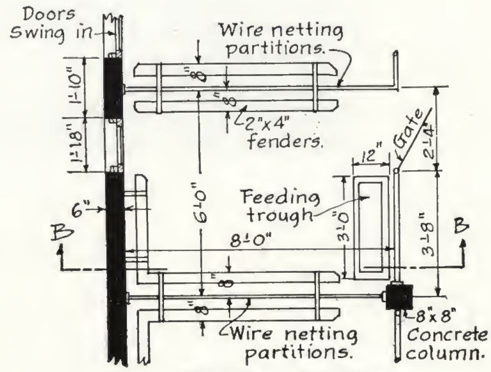
Concrete feeding troughs are a great aid in preventing the food from being spilled over the ground



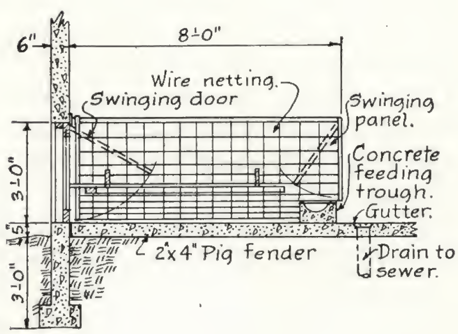
— LONGITUDINAL SECTION —



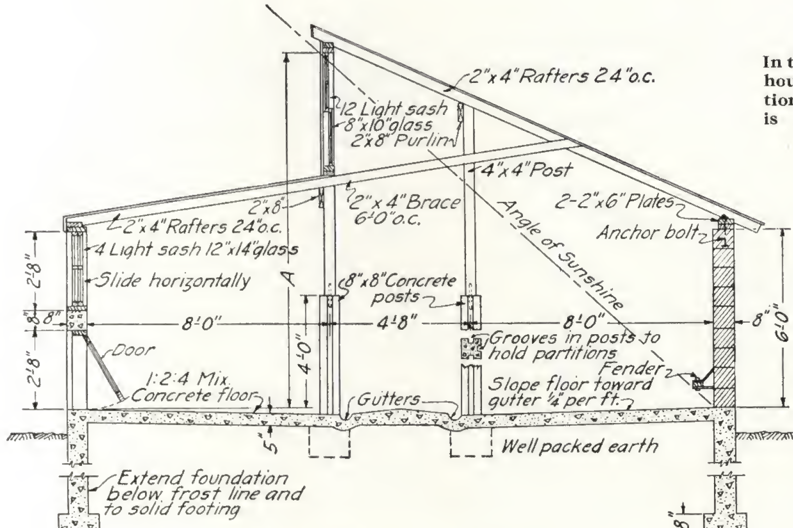
PLAN



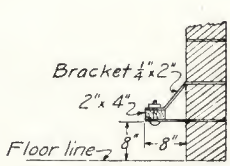
TYPICAL LAYOUT OF PEN.



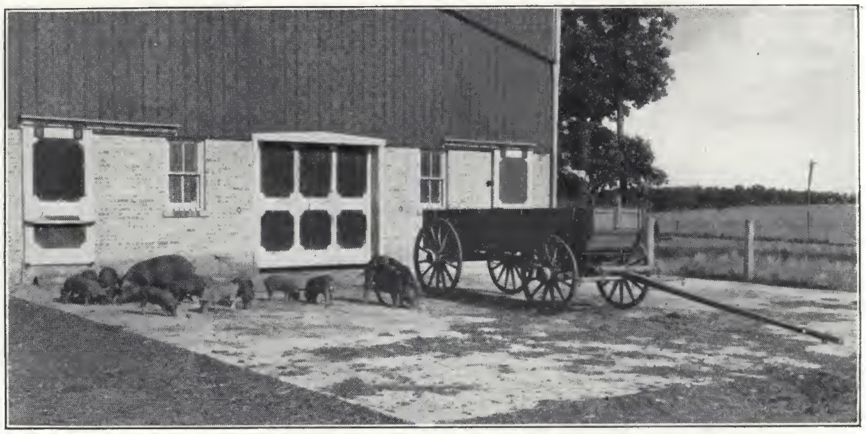
In the construction of a hog-house take into consideration the fact that sunlight is indispensable to sanitation



Section through typical hog house



DETAIL OF FENDER



A small concrete feeding floor also affords easy access to the barn

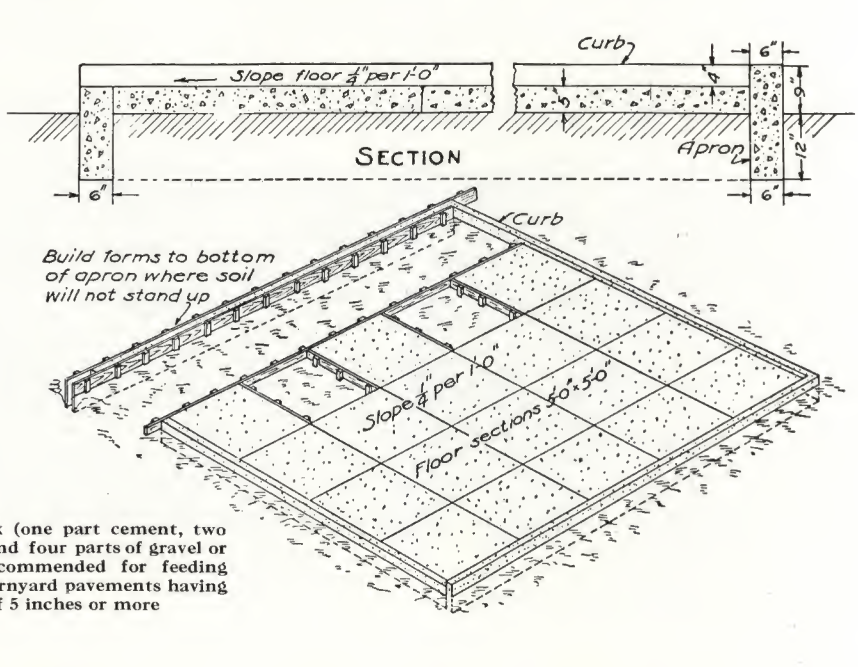
Feeding Floors

FEEDING floors and barnyard pavements are usually composed of slabs 5 to 10 feet square. Forms are set so that the slabs can be constructed alternately. Care must be taken to stagger the adjoining divisions, in order to have continuous joints in the finished work, as shown in the illustration below.

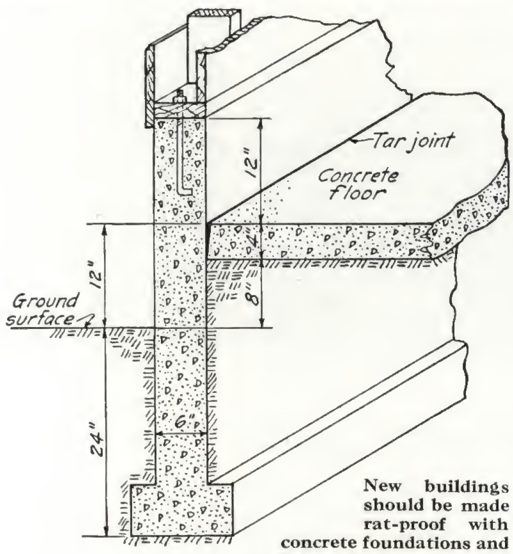
The enclosure made by the forms is filled with the mixed concrete, which is struck off as nearly level as possible by guiding a strike-board along the top of the forms. The concrete is then rolled, if this is practicable. Usually a light steel roller, 10 or 12 inches in diameter, weighing about 75 pounds for a six- or eight-foot length, is used. After this, the surface is finished by hand float or belt.

Surface drainage of floors and pavements is accomplished by giving the pavement a slight slope in one or two directions. Barnyard pavements and feeding floors are generally sloped about ¼ inch to the foot toward a gutter, preferably built as a part of the floor. This gutter should also slope toward a drain to carry off the water.

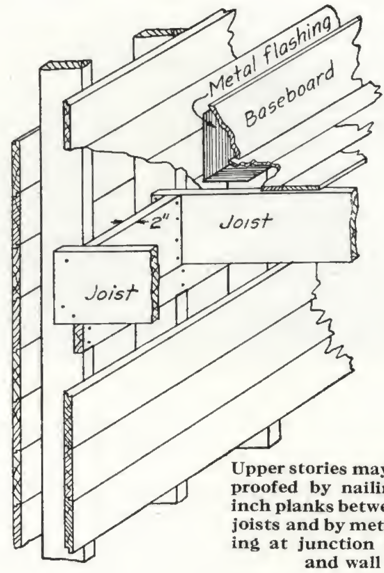
To prevent animals, while feeding, from shoving grain from the concrete floor, a curb should be built around it. This is particularly necessary for a hog feeding floor. This curb should extend 18 inches below the base of the floor, so that the animals will not root beneath it, and should project 2 or 3 inches above the floor surface.



A 1 : 2 : 4 mix (one part cement, two parts sand, and four parts of gravel or stone) is recommended for feeding floors and barnyard pavements having a thickness of 5 inches or more



New buildings should be made rat-proof with concrete foundations and floors



Upper stories may be rat-proofed by nailing two-inch planks between floor joists and by metal flashing at junction of floor and wall

Building Out Rats

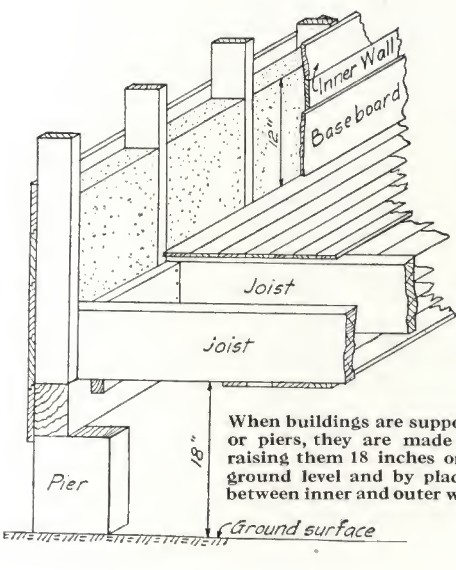
RATS destroy and waste great quantities of grain. They are a menace to health because they carry disease.

All farm buildings should rest on concrete foundations and have concrete floors, even though the building itself is not concrete. Therefore, the first step in rat-proofing is to construct all ground level floors of concrete. These floors should be no less than four inches thick, and should be placed directly on the soil so there will be no space underneath for rats to find shelter.

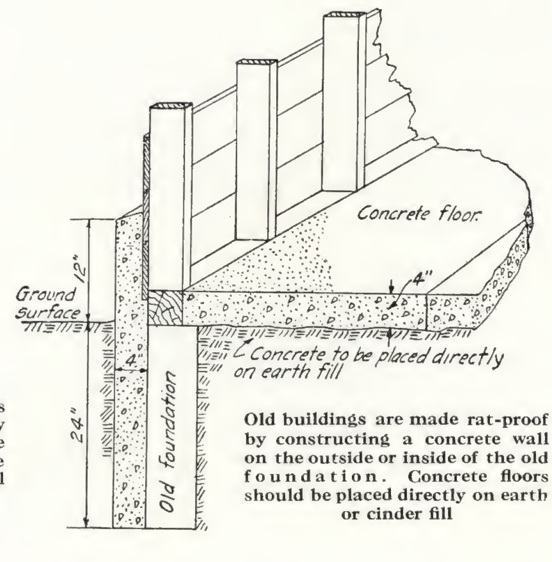
Foundations must be carried 24 inches below ground level, to prevent the rats from burrowing beneath them. The concrete foundation should also extend 12 inches above the floor.

Old buildings can be given an effective rat-proofing by carrying up false foundation walls on the outside to such a height that the rats cannot find a resting place while attempting to gnaw into the building. Floors and foundation walls should be so joined that there will be no gap of earth through which the animals can burrow into the building.

The accompanying illustrations will show the various methods of rat-proofing in both old and new buildings.



When buildings are supported on posts or piers, they are made rat-proof by raising them 18 inches or more above ground level and by placing concrete between inner and outer walls above sill



Old buildings are made rat-proof by constructing a concrete wall on the outside or inside of the old foundation. Concrete floors should be placed directly on earth or cinder fill

Concrete Fence Posts

CONCRETE fence posts are a permanent improvement to a property. They will stand for years without deterioration, whereas wooden posts rot, burn or become riddled by wood borers. The first cost of concrete fence posts is the only cost, whereas hardwood posts cost almost as much and last but a few years. Concrete posts are easily constructed, and the work can be done in winter months or when outdoor work is not possible.

The various types of commercial post molds on the market are not expensive and will be of advantage if many posts are needed. Molds can also be made with clear, straight-grained lumber. Before using wooden molds saturate them with a mixture of boiled linseed oil and kerosene to prevent the concrete from sticking. Reinforcing rods are placed in the proper position while filling the molds. Jarring or tapping the molds and stirring the concrete while filling will release air bubbles and work the coarser particles away from the surface, producing a smooth finish.

Steel rods, ¼ inch to ⅜ inch round, must be placed in concrete posts to resist strains. To be most effective, these rods must be correctly placed. In a square post, the reinforcing should be placed near the surface at each of the four corners. Correct positions for reinforcing rods for the various shaped posts are illustrated.

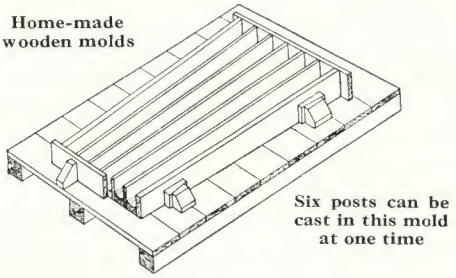
A 1:2:3 mixture (one part cement, two parts sand, and three parts gravel or broken stone) is best for concrete posts.

Clean coarse sand, ranging from fine particles up to those ¼ inch in size should be used, and the pebbles or broken stone should be graded from ¼ inch to a maximum size of ¾ inch.

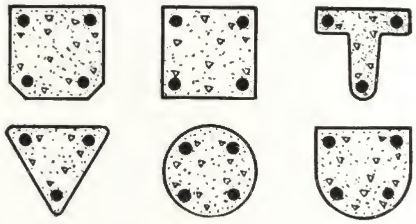
The posts, as soon as removed from the molds, should be protected from excessive cold, sun and dry winds. Harden them by covering with straw, and keep wet for a week or ten days. At the end of this time, move them outside and stand on end. Thirty days later they are ready for use.

There are many methods of attaching line wires to concrete posts, but the most practical and simple way is to tie the fencing to the post by wire loops such as are used by telegraph linemen in attaching wires to insulators. Attach the tiewire to the fence, carry it around the post, and again fasten to the fence.

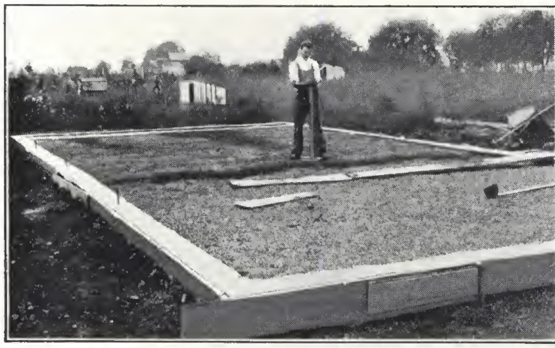
While staples may be cast with the post, they make it necessary to set all posts at the same depth, which is not always practicable. Holes cast in posts cause a weakness except in the case of large corner or gate posts.



Six posts can be cast in this mold at one time



Reinforcing rods must be placed at points of greatest stress



A concrete floor is permanent and sanitary

A concrete incubator cellar located partly below ground

Poultry Houses

SECTIONAL climatic conditions and the particular requirements of the individual determine to a large extent the design and the construction of a poultry house. The state agricultural colleges, as a result of constant experiment and observation, can recommend the most efficient and practical houses for their own localities. Write them for working plans giving details of construction.

While the house should be economical in cost, any points in the construction that will increase the health and vigor of the flock is a good investment, even though a slightly higher initial expense is involved.

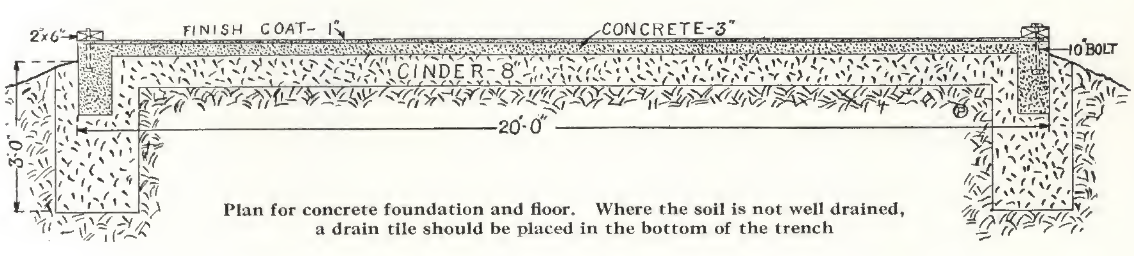
Foundation and Floor

Damp floors are the cause of a common and undesirable form of moisture. A properly constructed concrete floor prevents seepage of the soil water and keeps the litter dry. Furthermore, because of its smooth, hard surface, you can easily sweep, wash, and disinfect it.

A good foundation will keep rats from burrowing under the floor, and prevent heaving by frost. The trench for this foundation wall should be three feet deep and one foot wide. In soils that are not well drained, a round or agricultural tile should be laid at the bottom of the trench with a slight pitch to one corner, leading to a drain. Fill the trench with 18 inches of coarse stone, sifted gravel, or cinders dampened and firmly packed. Now place the forms for the foundation wall, which should be 8 inches thick and extend 6 inches above the ground. A mixture of 1: 2½: 4 concrete (1 part cement, 2½ parts of clean, sharp sand graded through a ¼-inch screen, and 4 parts of crushed stone or gravel) is recommended. Bolts should be imbedded in the wall every 10 feet, to fasten the sills. Foundations for interior posts are built with box forms.

The floor may be laid before or after the house is built, depending on weather conditions. Remove soil to a depth of 12 inches from the top of the foundation wall, and firmly tamp down 8 inches of cinders. Now place a 3-inch layer of 1 : 2½:4 concrete, and finish with 1 inch of 1: 3 mixture (one part of cement and three parts sand), care being taken to seal all cracks between the foundation and the sill. Place the top coat before the base has commenced to harden, to insure an effective bond between the two courses.

Exposure to sun and wind immediately after completion deprives concrete of a great deal of strength. To properly cure the floor, allow it to dry out slowly. Cover it with a few inches of straw and keep wet for several days.



Plan for concrete foundation and floor. Where the soil is not well drained, a drain tile should be placed in the bottom of the trench

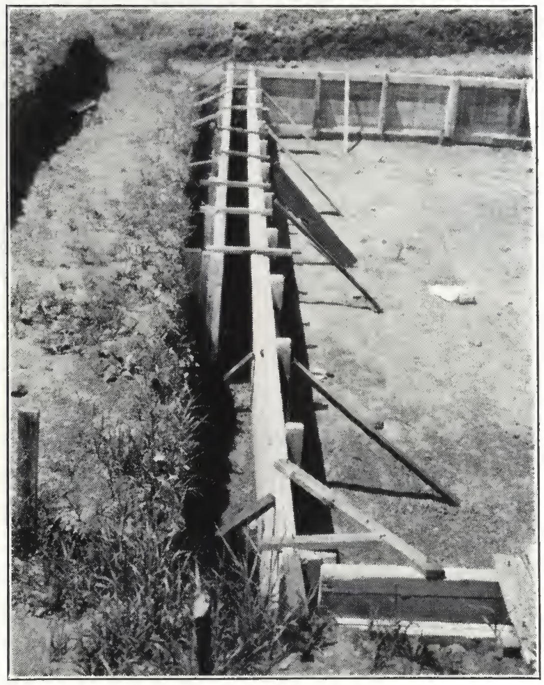
Foundations and Walls

THE thickness of foundation walls depends upon the load to be carried. Walls for houses, garages, and barns range in thickness from 6 to 10 or 12 inches. Foundation walls for buildings without a basement need not be made of a very rich mixture, as absolute water-tightness is not necessary. Therefore, a 1:2½:5 or 1:3:6 mixture may be used. For water-tight wall construction a 1:2:4 or 1:2½:4 mix (in extreme cases, where much ground water is to be encountered, a 1:2:3 mix) should be used for the foundation walls of buildings with basements.

Where soil conditions lack good supporting capacity, the foundation wall is usually built on a footing. A good bearing area is usually secured by spreading out a footing about 10 or 12 inches wide and 6 or 8 inches thick. Dimensions of footings must be varied in accordance with the bearing capacity of the soil. It is not possible to give a uniform width for footings. The average barn has walls from 8 to 10 inches thick, and may require a footing 2 feet wide and 12 inches thick to support the load. For a two-story house having eight-inch walls, soil conditions may require a footing 18 inches wide and 12 inches thick.

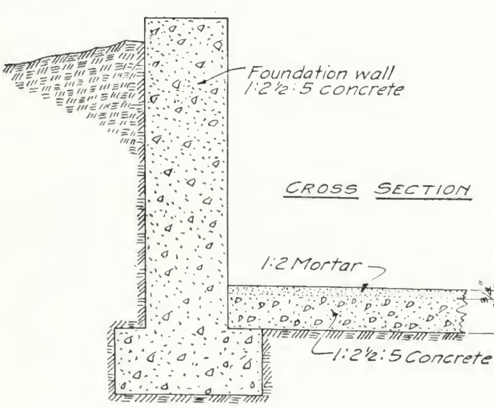
In excavating for foundations the trench should be carried deep enough so that its bottom will extend to firm bearing soil, below possible frost penetration. Otherwise upheaval due to expansion of the soil when freezing may cause cracking of the foundation, and the crack may possibly extend up into the structure of the wall.

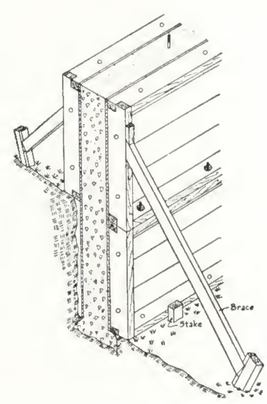
Monolithic walls above ground are usually made of a 1:2:4 or 1:2½:4 concrete.



Sturdy forms maintain correct lines

Concrete block are used extensively in all kinds of foundation work particularly for small and medium-sized structures. Usually an ordinary concrete footing is laid first and the block masonry wall started upon this. Be sure the block are well and uniformly bedded in a rich cement mortar, not leaner than 1:2½ or 1:3 (1 part of cement and 2½ or 3 parts of sand), and that all joints are well filled and pointed. If this is not done, there is danger of leakage. As an added precaution, block foundation walls are usually given a quarter-inch coat of rich sand-cement mortar on the exterior before the foundation trench is filled.





Only a few simple tools are required. For a neat job, a groover and an edger should be used

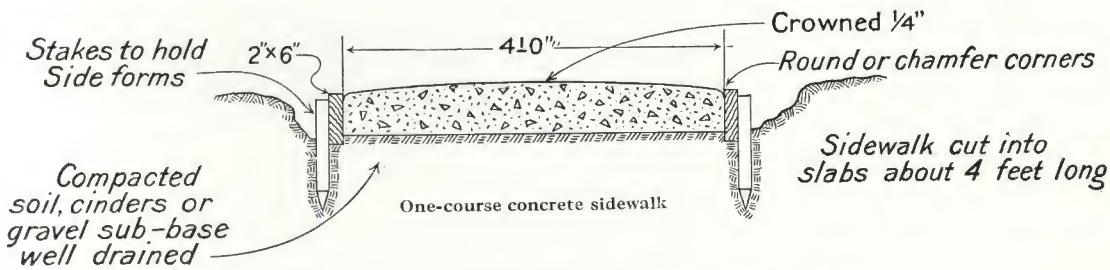
Sidewalks and Pavements

CONCRETE sidewalks have proven their usefulness from the standpoint of economy in first cost, low maintenance, safety, cleanliness and good appearance. Concrete pavements should rest on a firm, well-compacted base. Soft spots should be dug out, filled with clean gravel, and tamped. Good drainage beneath the pavement should be provided when necessary. A specially prepared sub-base of gravel or cinders is seldom required if the natural soil drains freely, is well compacted, and slopes slightly so that free drainage is always present.

If the soil is dense and tends to be waterlogged during protracted rainy spells, a special sub-base of gravel or cinders may be necessary. Unless this is properly placed, however, it may cause more difficulties than would its omission. If this sub-base is nothing more than a filled trench, it will collect water and make the walk unstable, and expansion due to freezing would heave the walk and break the slabs or throw them out of level.

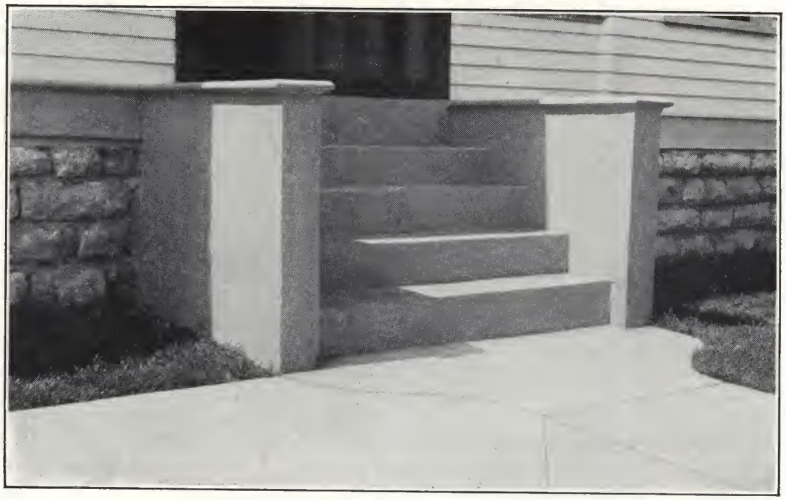
Concrete walks are usually laid in a continuous stretch, although they may be built by concreting alternate slabs first and intermediate ones last. It is important that each slab be completely independent of adjoining ones. The joint marking the end of one slab and the commencement of another should be continuous through the concrete to the soil upon which it rests, in order that any slight disturbance of the walk, due to upheaval or settlement, can be corrected by raising or lowering the slabs.

One-course construction is recommended. The walk should be built throughout its thickness of one relatively rich mixture of concrete, such as 1 : 2 : 3 or 1 : 2 : 4 (one part cement, two parts sand, and three or four parts of gravel or stone). Experience has proven that one-course construction is more reliable than the two-course type.



4 Feet Wide. (One Course.) 1:2:3 or 1:2:4 Mix

.417 × 4 × 1 = 1.668 cu. ft. or .062 cu. yd. of concrete per lineal ft. of sidewalk



Concrete steps with cheek walls

Steps and Stairways

STEPS receive hard wear. They are exposed to rain, snow and ice, and are usually in contact with the soil. Unless made of concrete, they are the first part of a building to require repairs. Concrete steps need be built but once—they are there to stay. They do not wear out, and the treads never become loose and unsafe.

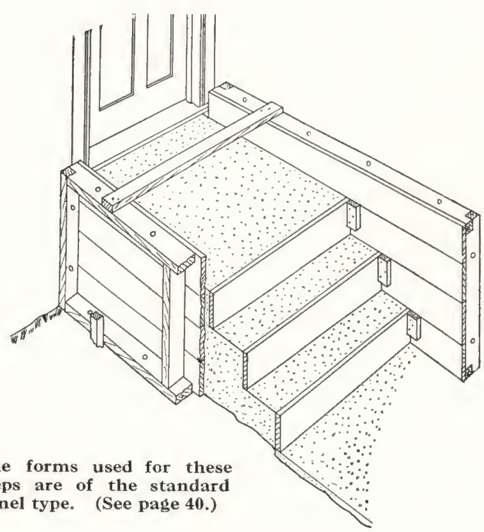
Forms for concrete steps are easily made. For steps leading to the house, forms may be constructed with very little labor by using the standard panels described on page 40. The illustration shows the method of arranging these panels.

Construction details for outside steps leading to the basement are also illustrated. Forms are not needed for the underside, as the concrete is placed on the soil. The side walls are placed first in the same manner that a foundation wall would be built. Earth is then filled in and thoroughly tamped to provide a firm base on which to place the steps. The riser forms are supported by a 2 by 6 inch board braced against the side walls.

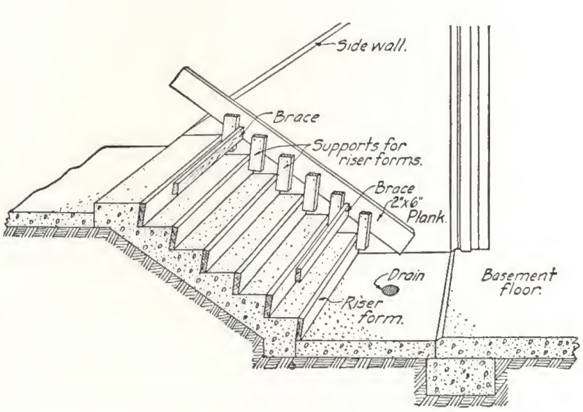
The treads of concrete steps should be finished with a wood float to provide a non-slip surface.

It is recommended that a drain be placed in the bottom landing slab, to carry off water.

A 1:2:4 mix (one part cement, two parts sand, and four parts of gravel or stone) is recommended for concrete steps.



The forms used for these steps are of the standard panel type. (See page 40.)



Concrete basement steps are not hard to build by the use of easily made forms as shown in this sketch. This set of steps is an asset to any building

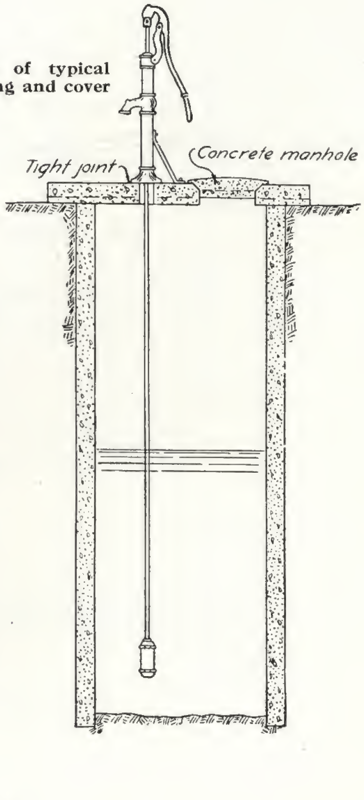
Well Covers and Linings

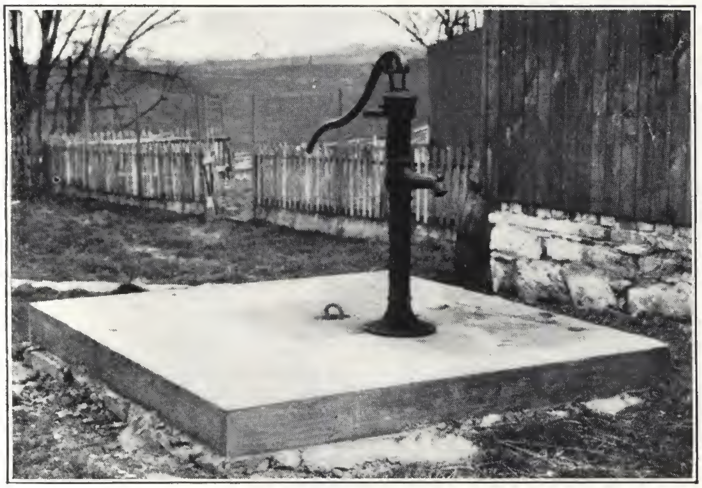
A CONCRETE well lining and cover will permanently insure the water supply against contamination by surface drainage. Where a well is the source of a domestic water supply, this simple safeguard to health should not be neglected.

A concrete well lining should extend into the well to a depth of six to eight feet below the ground level, or to a sufficient depth to keep seepage of surface water out, and to prevent animals from burrowing beneath it. When building a new well it is desirable to line it with concrete from bottom to top. The work is thus finished for all time.

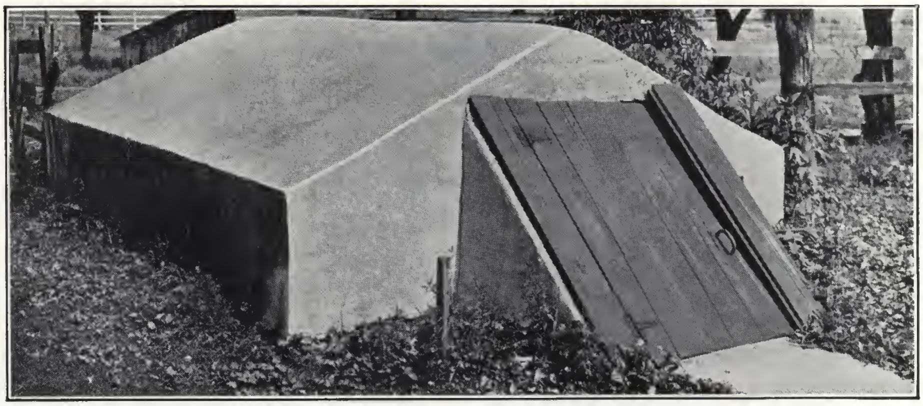
A 1:2:3 mix (one part cement, two parts sand, and three parts of gravel or stone) is best for well linings. A 1:2:4 mix is satisfactory for the cover slabs when reinforcing rods are used.

Diagram of typical well lining and cover





A concrete well cover is sanitary and serviceable



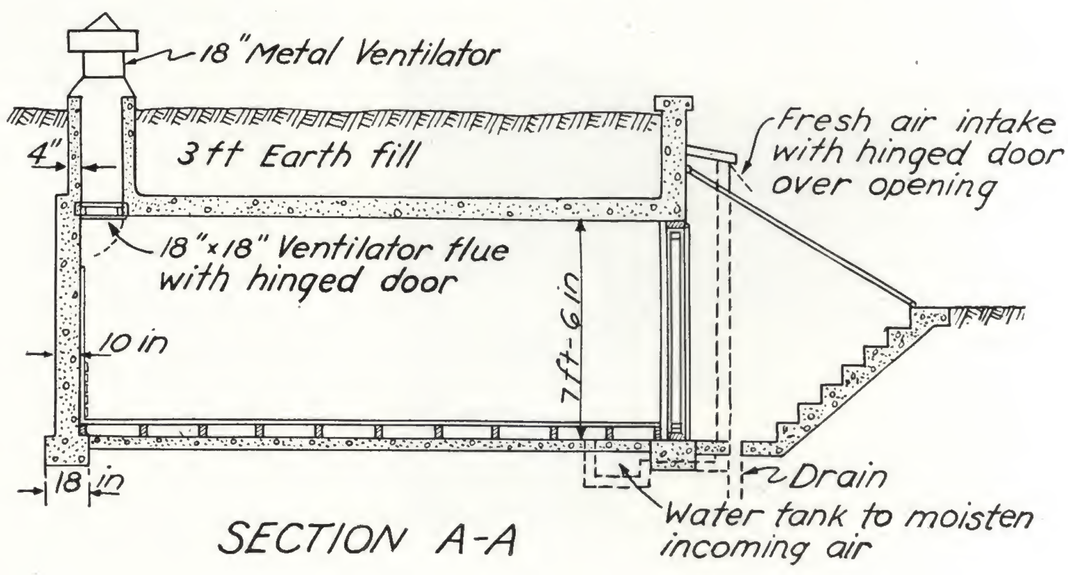
A small monolithic covered storage cellar with concrete entranceway and peaked roof

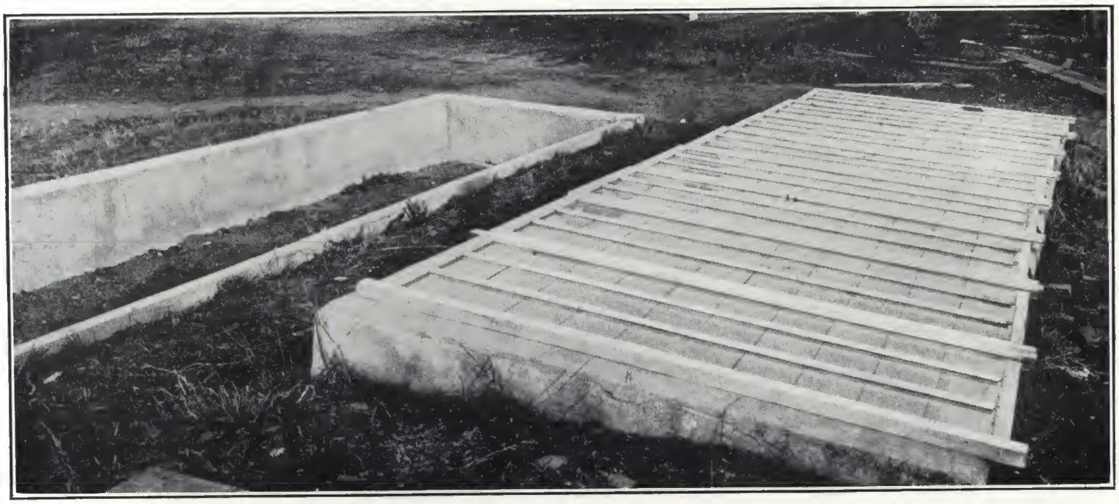
Fruit and Vegetable Storage Cellars

IN a properly designed concrete fruit and vegetable storage cellar the ventilation and the regulation of moisture and temperature can be accomplished with less difficulty than with any other kind of structure. For best results the cellar should be at least partly under ground, in order to protect against extreme outside temperatures. A hillside location is most desirable because less earth need be handled in excavating. Not every farm has the same storage requirements, and no one design is likely to meet all individual needs.

Storage cellars may be built either monolithic or of concrete block. Sometimes the latter type of construction is particularly advantageous because of the insulation introduced in the wall through the cells in the block. If similar insulation is desired in a monolithic concrete cellar, it may be secured by laying up a hollow block wall on the inside.

Suitable ventilation is absolutely essential in a storage cellar. Proper atmospheric control is necessary to keep fruit in prime condition. Sudden changes in temperature will cause excessive condensation of moisture on the walls. During cool evenings manhole and cold-air intake covers should be opened to permit cold air to pass down into the cellar and circulate throughout it, closing them during the day. In cold weather these openings may also have to be closed, and in more extreme cases a moderate amount of heat may have to be maintained in the cellar in order to keep the temperature from getting below freezing during protracted cold spells.





Start your early Spring plants in a concrete hotbed

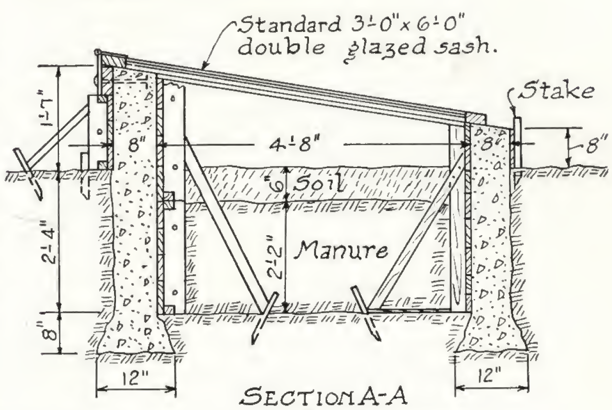
Hotbeds and Cold-Frames

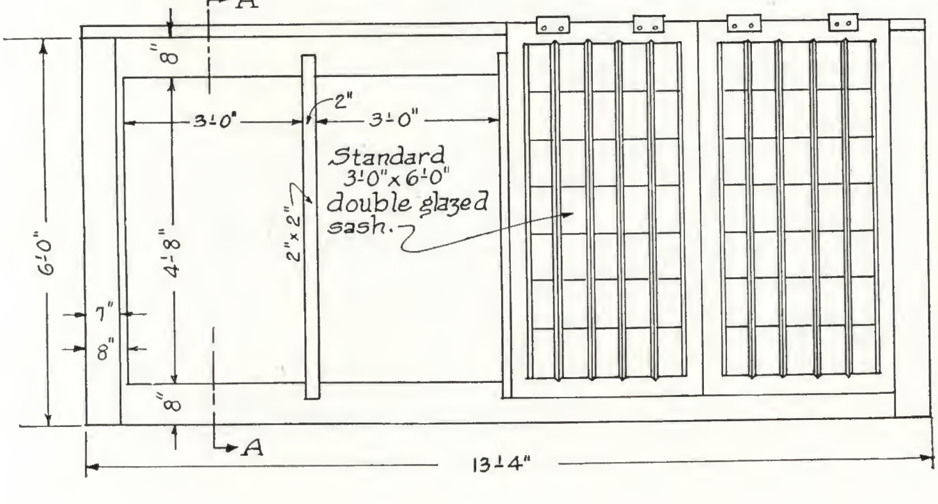
A HOTBED should be located so that it slopes toward the south, and should be protected from cold wind. The standard hotbed sash is 3 by 6 feet, and the size of the bed should be governed by the number of sash to be used.

The hotbed walls should be 6 or 8 inches thick, and carried down below possible frost penetration. Forms can be easily set up, as shown in the illustrations, and roughly supported by stakes and braces.

Reinforcement is not necessary unless the walls exceed 25 feet in length, when two ¼-inch rods may be laid at the center of the wall, 4 and 18 inches respectively from the top, to prevent cracks from temperature changes. A four foot length of ¼-inch rod bent to reinforce the corner, will prevent cracking.

A 1:2½:5 mix is best for hotbeds (one part cement, two and one-half of sand, and five of gravel or stone).





Smokehouses

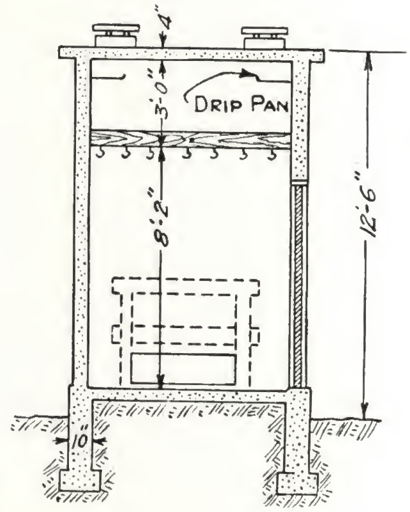
CONCRETE is ideal for a smokehouse because it is fire-proof and rat-proof. The fire-box should be located entirely outside of the smokehouse proper, to insure better regulation of fire and smoke control. Down draft into the flue leading to the center of the smokehouse reduces the draft somewhat and makes a denser smoke. The dimensions of the house will vary in accordance with individual requirements. It is preferable to hang meat at least seven feet above the floor, for the double purpose of securing even smoking and to keep it away from extreme heat.

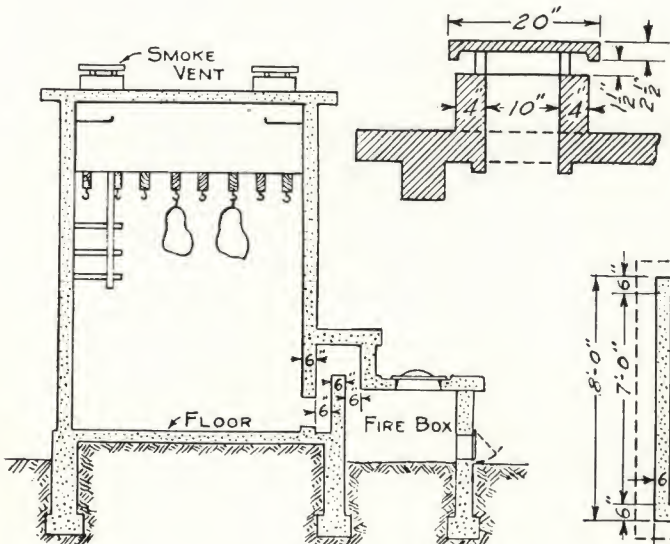
Concrete block may be used for building smokehouse walls, care being taken to lay the block with well-filled joints. No reinforcing will be required when eight-inch block are used for walls. A concrete smokehouse should not be used until the concrete is at least thirty days old, as heat from the fire will cause the concrete to dry too rapidly, and become soft and crumbly.

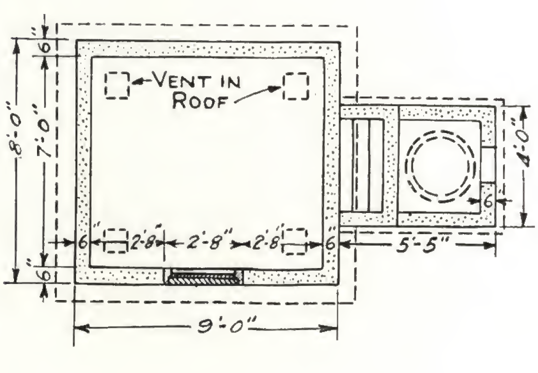
For a monolithic concrete smokehouse, a 1:2:4 mix (one part cement, two parts sand, and four parts gravel or stone) is recommended.

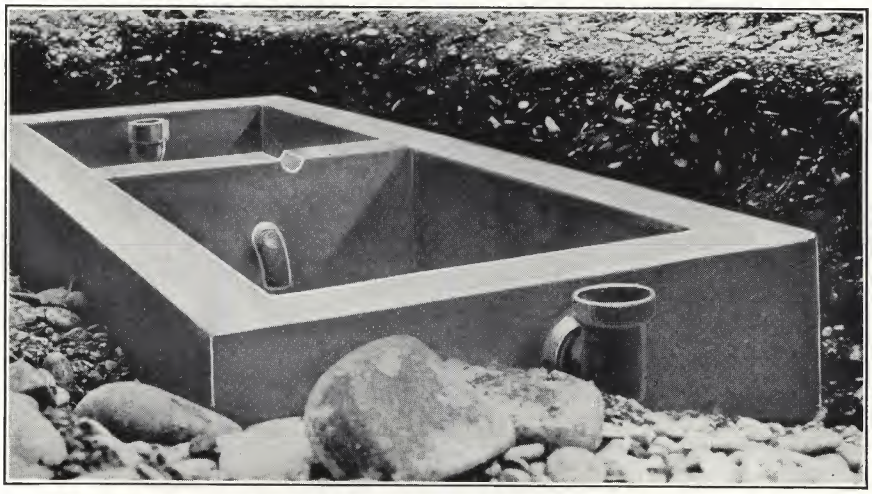
When forms such as are used in constructing silos are available, circular smokehouses may be built. An advantage of the circular structure is the more uniform distribution of smoke.

Concrete is ideal for a smokehouse because it is fire-proof and rat-proof









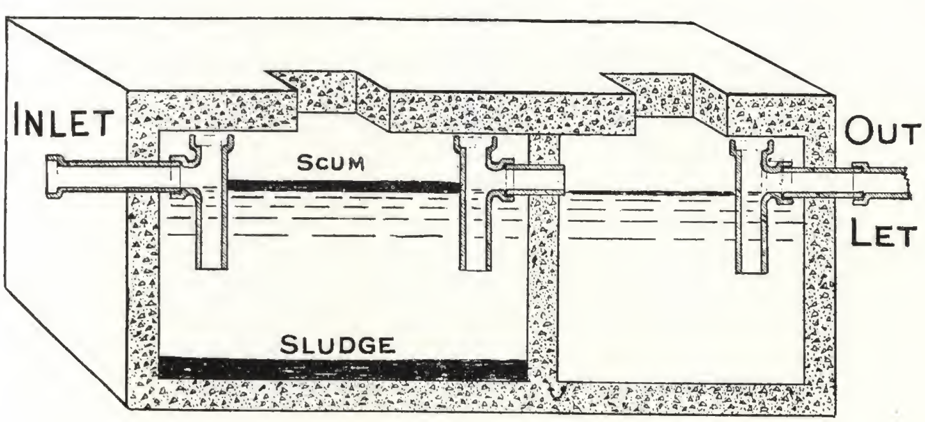
A concrete septic tank is good insurance against contamination of the water supply

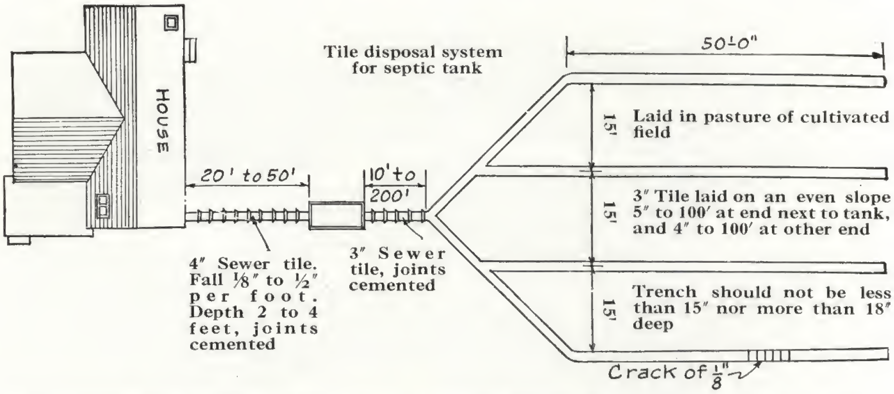
Septic Tanks

SEPTIC tanks operate by bacterial action. If ordinary household waste is confined in a practically air-tight and dark compartment, such as the first chamber of a septic tank provides, the solids start to dissolve, due to the development and action of bacteria. These bacteria feed on the solids and semi-solids in the wastes and convert them into gas and relatively harmless compounds. After certain transformation in the first compartment, the contents are discharged into a second compartment, where further transformation takes place and the sewage is rendered even less harmful. Finally, the second compartment discharges into a tight tile line, which should have laterals laid with open joints through which seepage of liquids into the soil can take place, where final and complete destruction of harmful elements is performed by the action of other bacteria native to the soil.

Septic tanks can be constructed in the form of a box, with one or two compartments. The tank should have a capacity sufficient to contain a twenty-four-hour flow of sewage from the household which it serves. Required capacity can be approximately determined by estimating that the discharge into the tank will range between 30 and 50 gallons per person per day. In a two-compartment tank, there should be 6 to 8 cubic feet of space in the first chamber. The second chamber may be smaller. The length of the tank should be about twice its width, so that uniform velocity of flow through it may be obtained.

The scum must not be broken, disturbed unnecessarily, nor allowed to leave the first compartment, as it is the home of the bacteria which do the work of sewage reduction. The entrance of household wastes into the tank will break the scum unless prevented by baffle





A miniature home sewage disposal plant will, within natural limitations, dispose of household wastes in a manner to render them practically harmless. This diagram illustrates the method of connecting the tank to the house and in turn to the tile lines leading to the disposal field

boards or Y-pipe fittings, the latter to have one end submerged below the constant level of fluids in this compartment.

A grease trap should be placed in the line from the house to the tank.

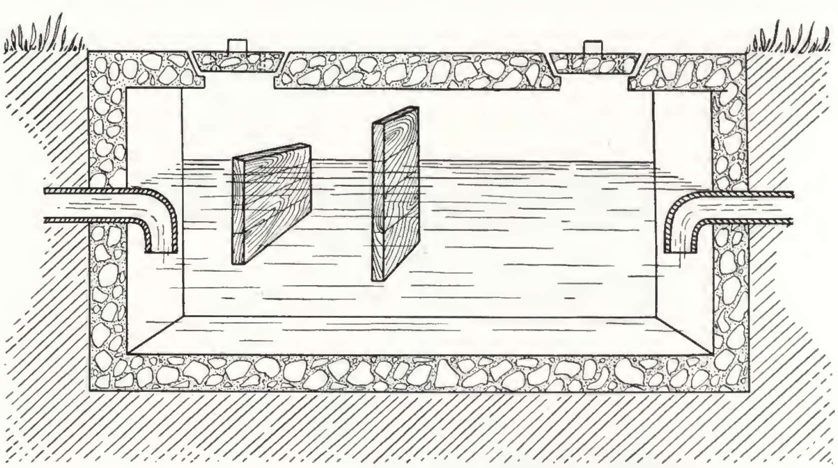
The discharge from the second compartment should be carried by a line of concrete drain tile, laid with cemented joints, to the point where final disposition is to be made of the waste. This area is called the disposal field. The lateral lines receiving the discharge from the main tile line should be laid with open joints.

The septic tank may be placed wherever convenient and at any desired distance from the house. The distributing area should have 20 feet of four-inch tile per person, and should be at least 200 feet from any shallow well.

A 1:2:4 mix (one part of cement, two of sand, and four of gravel or stone) is recommended for septic tanks. The bottom, walls and top of the tank should be 4 to 6 inches thick. The top should be reinforced with iron rods.

The forms needed for a septic tank are similar to those used in the construction of a watering trough. As the work is not exposed to view, rough lumber can be used. If the earth walls of the excavation are firm enough to stand without caving, they can be used in place of an outer form. Care should be exercised, however, in pouring the concrete, so as not to break down this wall and mix the soil with the concrete.

Forms for the side walls can be removed in twenty-four to thirty-six hours. Forms for the roof slab should be permitted to remain longer, particularly in cold weather, until it is certain that the slab is strong enough to sustain its own weight. The roof slab can, if desired, be cast separately and moved into place after it hardens.



Cross-section of septic tank with baffle boards in place. Inlet and outlet pipes are cast in position

Land Drainage

DOES your farm contain fields that are too wet early in the season when plowing and planting must be done? Perhaps only a small portion of the soil is wet, yet this section stops the work on the entire field. At times water from higher ground will drain across valuable land and keep it wet until late in the season. By the time the field can be plowed, the growing season has advanced and a poor crop results. A line of concrete drain tile is the practical remedy for this condition. An open ditch will take off the water, but is objectionable because it divides the field.

Crops derive great benefit from land drainage. Drainage removes excess water, leaving the pores of the soil open for the circulation of air. The direct results are:

1. A larger area to feed the plant roots due to the elimination of the water-logged soil.

2. Drought resistance because of the larger root system that is developed.

3. A warmer soil because there is less water and better circulation of air.

4. More available plant food because of the bacterial action, and more rapid decay of vegetable matter under the warmer conditions.

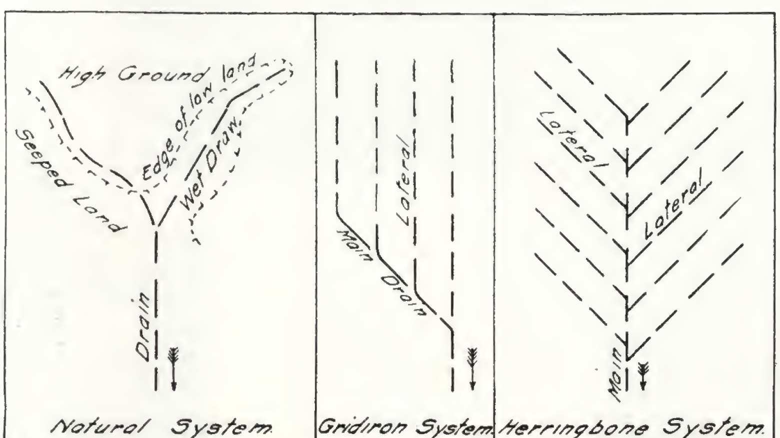
5. Better soil structure due to humus, air, and bacteria.

6. Better upward movement of water, giving plants a more uniform supply of food.

7. Prevention of surface loss, as water passes freely through the soil, instead of washing over it.

8. A longer growing season because of the earlier planting.

The increase in crops will pay for the cost of land drainage in one or two years, and the land has an increased selling value.



Arrangement of drains depends on local conditions. In the natural system, the drain follows the course of the flood water. The gridiron and herringbone systems are used for draining large areas of comparatively level land

Drainage Systems Should be Carefully Planned

Land drainage is most effectively accomplished through the use of concrete tile. Concrete tile are permanent; they are uniform in shape, and therefore easy to lay; and are not subject to disintegration from frost action.

The location and arrangement of the drains depend upon your local conditions. Three of the most generally used systems are illustrated. The average depth for placing tile is 2½ to 3 feet. An outlet for the water is absolutely essential, and on flat lands is frequently the most difficult part of the problem.

The volume of water which a system will carry is governed by the size of the tile and the rate of flow. The usual requirements call for a system that will carry off, in 24 hours, ¼-inch of water from the area to be drained. Where the rainfall is extremely heavy, a run-off of ⅜-inch or even ½-inch in 24 hours is used as a basis for estimating.

The factors which determine the size of the tile are as follows:

1. Area. The size of the tile depends largely on the area to be drained and on the spacing of the lateral tile lines. In close, dense soil, these lines can be placed 30 to 40 feet apart; in clay loam and sandy clay soils, 60 feet; in sandy loam soils, 100 feet; and in gravel soils, 150 to 200 feet.

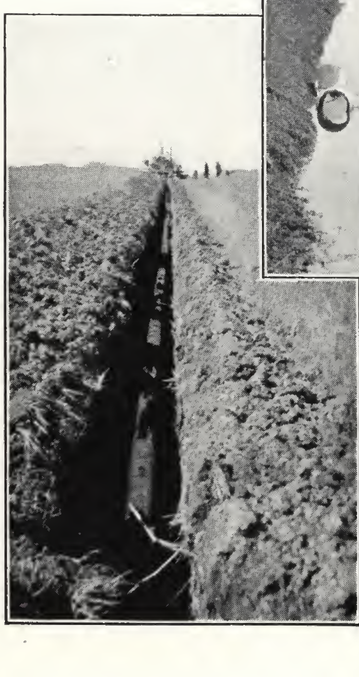
2. Fall or slope. Water flows more rapidly when the slope is steep, consequently smaller tile can be used.

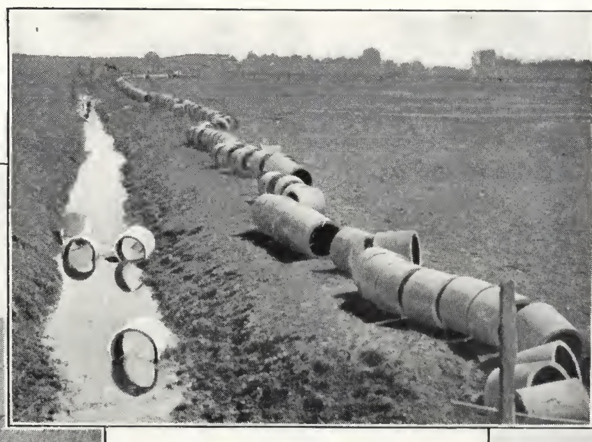
3. Texture of the soil. Water passes through porous sandy soil more readily than through dense clay, and therefore larger tile are required to handle the flow.

4. Amount and intensity of rainfall. Sections of the country having heavy rainfall require quick draining, and larger tile must be used.

The employment of an experienced man to lay out the system will save money through avoiding costly mistakes, as the work requires a thorough knowledge of the drainage properties of the soil. While the entire system should be planned at one time, the installation can be made in sections at different periods.

Experience and special equipment are necessary to turn out a satisfactory drain tile. Practically all the smaller sizes are made by machine. It is best to buy your drain tile from a reliable source.





An open ditch divides the field in two parts and requires cleaning every year. Concrete drain tile will replace this ditch and return the idle strip of ground to cultivation

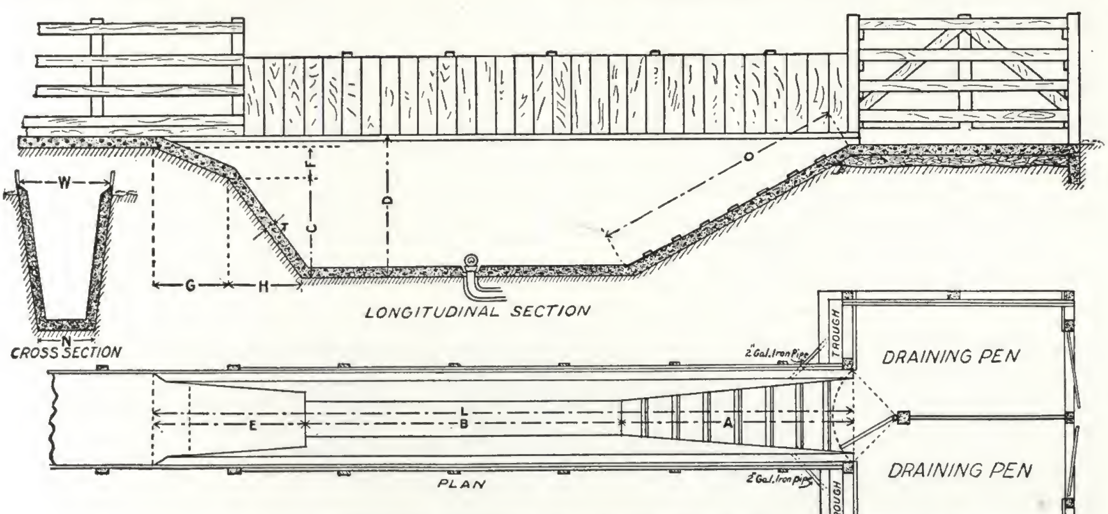
Dipping Vats

A CONCRETE dipping vat, built of good materials and properly constructed, is always ready for use and will prove a paying investment. It is not injured by moisture, it will not rot or rust, and it requires no repairs.

A vat with sloping sides is generally considered more desirable than one with straight sides, because of the saving in quantity of dipping solution needed.

A 1:2:3 mix (one part of cement, two parts sand, and three parts of gravel or stone) is recommended for the construction of concrete dipping vats.

The diagram shown below illustrates construction details of a concrete dipping vat for horses, cows, sheep, or hogs. The dimensions, of course, will vary according to its proposed use, as shown by the chart, the letters at the top of each column corresponding to those shown in the diagram. The draining pens should be made large enough to accommodate the animals to be dipped.



Details of construction of a concrete dipping vat

Kind	W		N		D		L		E		B		A		G	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Horses	5	10	3	4	8	8	55	0	7	6	31	0	16	6	3	9
Cattle	5	4	3	4	7	8	51	0	6	8	31	0	13	4	3	4
Sheep	3	4	2	4	5	8	46	0	5	0	31	0	10	0	2	6
Hogs	3	4	2	4	5	8	36	0	5	0	31	0	10	0	2	6

Kind	F		H		C		O		T		Lehigh	Sand	Stone
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Barrels	Cu yds.	Cu. yds.
Horses	2	2	3	9	3	9	18	7	0	8	43	13	26
Cattle	1	11	3	4	3	4	15	4	0	8	37	11	22
Sheep	1	5	2	6	2	6	11	6	0	8	24	7	14
Hogs	1	5	2	6	2	6	11	6	0	8	19	5½	11

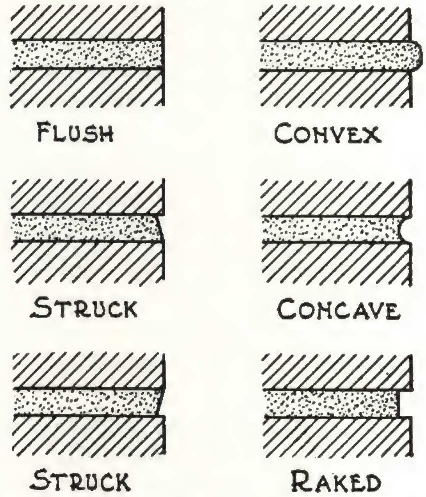
Concrete Block

THE use of concrete block simplifies the work of both designer and builder, and gives the owner the advantage of rigid, permanent, and maintenance-free construction, with a saving in both the cost and the time required to build. Concrete block can be laid rapidly, they bed firmly in the mortar, and provide a surface to which stucco adheres with great tenacity.

The principal types of concrete block are hollow block and two-piece block. Hollow block have cells or air spaces running vertically through the unit. Block of this type are illustrated in Nos. 1, 2 and 3 on the following page. Two-piece block, Nos. 4, 5, 6 and 7, provide a continuous air space in the wall. The inner and outer sections of the wall are bonded together in Nos. 5 and 7 by means of lugs or projections on the block which overlap in alternate courses. In No. 4 the walls are held together with metal ties that are imbedded in the block when they are made, while in No. 6 the metal ties are placed in the mortar bed when block are laid.

In both the hollow block and the two-piece block the amount of air space varies from 20 to 40 per cent. of their volume. Where extraordinary strength is required, solid blocks are used. These may be made by omitting the mold cores or by filling the air spaces with concrete after the block have been laid.

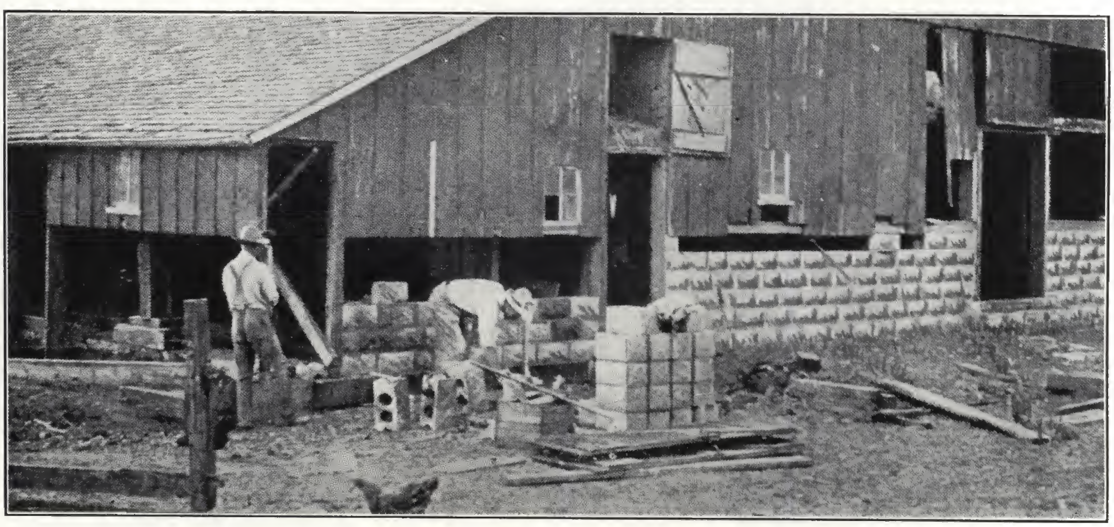
Concrete block are made in various sizes. The 8 by 8 by 16-inch block is perhaps the most common and makes a wall eight inches thick, with courses eight inches high.



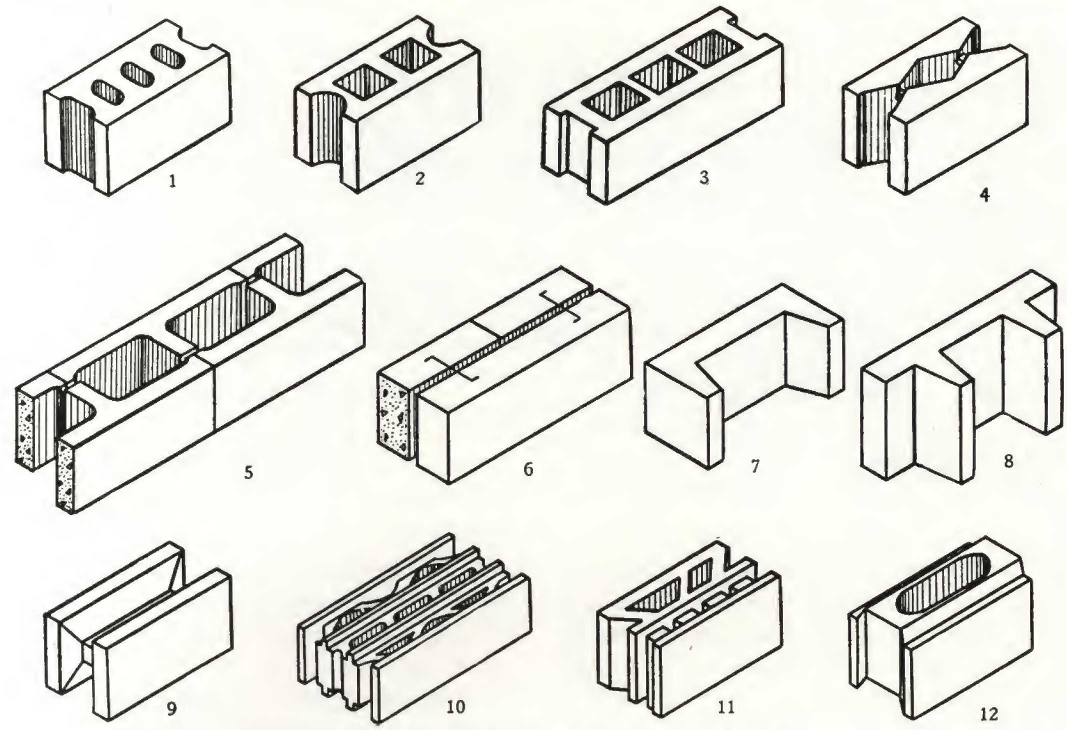
Mortar joints used in laying concrete block and building tile. The flush joint is used when stucco is to be applied. The struck joint and concave joint are recommended in face block construction

Surface Finish

There is a popular preference for stucco surfaces for houses and other buildings of moderate size because of the variety of artistic colors and finishes available. Concrete block provide an ideal backing for Portland cement stucco, as the surface of these units is suffi-



It is not difficult to place a concrete block foundation under a building whose sills have rotted away. Old buildings may be given a new lease of life with new walls of concrete block



Principal types of hollow block and two-piece block

ciently rough to produce a firm bond between the block and the stucco. The rigidity of concrete masonry construction is in itself an assurance against movement of the wall and consequent cracking of the stucco. Since concrete block and the cement mortar in which they are laid are of the same general composition and have practically the same absorption, the stucco hardens to a uniform color throughout its surface.

Concrete block are much used for both load-bearing and non-load-bearing partition walls. Standard units are used for load-bearing walls while special units from 4 to 6 inches thick are often used for partition walls that do not carry loads other than their own weight.

Concrete Staves

A CONCRETE stave is a slab of concrete, usually about 30 inches long, 10 inches wide, and 2½ inches thick. Some types of concrete staves vary slightly from these dimensions.

When used in the construction of silos or circular water troughs, the staves are held in place by wrought iron or steel hoops. The method by which the staves are joined differs according to the type. Some have tongued and grooved edges, while others have concave and convex edges, or other forms of interlocking edge. As a further safeguard against possible leakage at the joints, the inside surface of the structure is given a wash of cement and water mixed to the consistency of thick cream. This seals the joints and produces a smooth wall.

Concrete staves are widely used for silos. The erection of a stave silo is usually handled by the manufacturer, thus enabling the farmer to order a complete silo to be erected on his farm ready to be filled.

To keep silage, the juices must be prevented from leaking and the air kept out of the silo. A concrete stave silo keeps silage perfectly because it is air- and water-tight.

Ease and speed of construction are two important features in favor of the concrete stave silo. Three or four men can usually construct it in a few days.

The enduring and lasting construction of a concrete stave silo makes the first cost the only cost. Painting is not required, and there is no decay. It is permanent and fire-proof.

MANY people believe that the quality of concrete depends entirely upon the cement used. It is true that a high quality cement—Lehigh Portand Cement—should be used, but of equal importance are the selection of the other materials and the care exercised in the mixing.

Good concrete can be made by following these directions:

1. Specify "Lehigh" Cement.
2. Use clean, well-graded sand and stone.
3. Mix properly and completely.
4. Place carefully.
5. Use care while curing and drying.

Concrete is a product resulting from the proper mixture of cement, sand, stone or gravel, and water. Cement acts as a mineral glue, binding these materials firmly together.

Materials for Concrete

SAND, gravel and stone vary in quality and must be selected with care. Sand is often dirty, due to the presence of foreign materials, such as silt or organic matter. Rotted vegetable material may be present in such a fine form as to be difficult to detect; or considerable clay may be in the sand. Practically the same impurities may be found in gravel or crushed stone, particularly in gravel. The pebbles may be coated with clay and foreign material, which will prevent the cement from binding the mixture firmly together as a mass.

Satisfactory concrete cannot be produced by taking the natural run of material as it comes from the sand or gravel bank and using it with cement and water to form a concrete mixture. Practically every gravel bank contains more sand than pebbles. In concrete work, material that will pass through a ¼-inch screen is called sand, and material that will not pass this screen is called gravel.

It will therefore be observed that two preliminary operations are necessary with material as it comes from the gravel bank before it can be intelligently used for concrete.

(1) It must be screened through a ¼-inch screen to separate the sand and the gravel, so that these two materials can be re-combined in the proper proportions.

(2) The sand must be tested for cleanliness.

The Color Test for Sand

A test to determine the presence of loam or organic matter in sand is easily made. Obtain a 12-ounce graduated bottle and fill to the 4½-ounce mark with the sand to be tested. Add to this a 3% solution of caustic soda (one ounce of caustic soda dissolved in 32 ounces of water will make a 3% solution), until the combined volume of sand and solution amounts to 7 ounces.

Shake thoroughly for a few minutes, and let stand for twenty-four hours. At the end of this time observe the color of the liquid above the sand. If the liquid is colorless or nearly so,

—a pale yellowish color—the sand is sufficiently free from organic impurities for use in high grade concrete. A brownish-yellow liquid, or one darker than a pale straw, indicates a sand which should not be used in important concrete work, such as roads, pavements and reinforced concrete building construction. If the color of the liquid is brownish throughout, the sand may be used in unimportant work only, such as footings or foundations that are not to carry heavy loads. A dark brown liquid shows a sand which should not be used for concrete work unless it can be washed to remove the foreign materials.

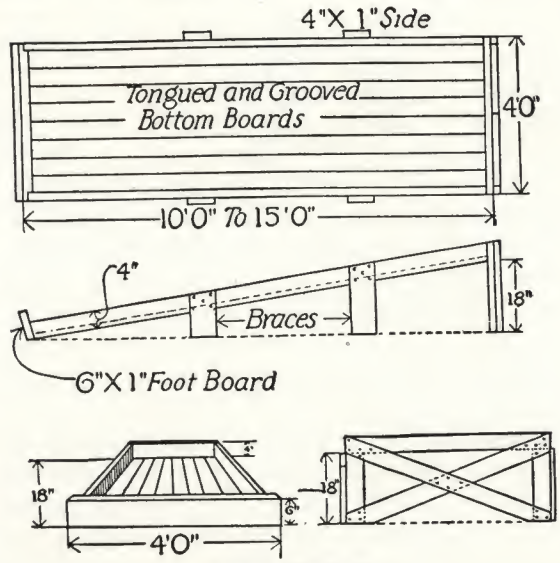
A very simple test to ascertain if the sand is clean is made by placing four inches of sand in a fruit jar, fill with water, shake thoroughly for a few minutes, then allow to settle. If, after settling, there is a ¼-inch or more of sediment above the sand, it will be advisable to wash the sand.

Washing can be done on an inclined platform, 10 to 15 feet long, with a slope of 12 to 18 inches. Strips at sides and end will keep sand from washing away. A stream of water running through the sand from the upper end over the baseboard will remove the dirt. Pebbles and screenings from crushed stone can be washed in a similar manner.

Sand and Gravel Must be Screened

In proportioning the materials for concrete, it is desirable to obtain as compact and dense a mixture as possible, in order that the concrete may be strong and durable. This is accomplished by using enough sand to fill all the space between the particles of stone or gravel, and sufficient cement to fill all the space between the two materials.

Suppose, for example, a box of exactly one cubic foot capacity is filled with as many pieces of crushed stone or pebbles as it will contain. No matter how carefully this volume of material, which in bulk measures one cubic foot, is shaken or settled into place in the box, there will be a large volume of unfilled space in the cubic foot of bulk because the large particles will not fit together so closely as to make a solid mass. A considerable volume of sand graded through a ¼-inch screen can be added, and, by thorough mixing, the box will hold both materials. Still there are unfilled spaces;



Washing Platform

and cement can be added to produce a dense mass that will make strong concrete.

Sand and gravel as it comes from the gravel bank will not produce a dense mass. Usually it contains twice as much sand as needed, and in order to control these proportions in the concrete mixture, the sand and gravel must be screened through a ¼-inch screen.

That which passes through the screen is termed sand; the large particles are called gravel. Now, being separated, each material can be used in the proportion needed to produce the grade of concrete required.

Where bulk is required, and no great tensile strength is needed, hard cinders from soft coal are often used in place of gravel or stone in order to reduce the dead weight of the construction. For roof slabs on short spans and for base courses under cement finish, cinder concrete will prove economical. Due to the greater percentage of voids in cinders, a slightly increased amount of mortar (sand and cement) must be provided.

Within reasonable limits, the strength of the concrete increases with the size of the stone or gravel. In the general run of concrete work, including thin reinforced sections, the size should not exceed 1 or 1¼ inches. In mass concrete, such as heavy foundations and thick walls and floors, the size of the stone or gravel may often range up to 2½ or 3 inches. Round or egg-shaped particles of stone or gravel pack more closely and produce better concrete than flat, elongated pieces.

Forms for Concrete Construction

FOR most concrete work, the forms are easily made. A concrete walk or driveway, for example, requires 2 by 4 inch or 2 by 6 inch side strips to form the edges, and cross pieces to limit the size of the various slabs into which the walk or drive is divided. In setting these forms it is necessary to level their upper surface or, if the work is not intended to be exactly level, then to set them so that the finished concrete surface will have the grade or slope desired.

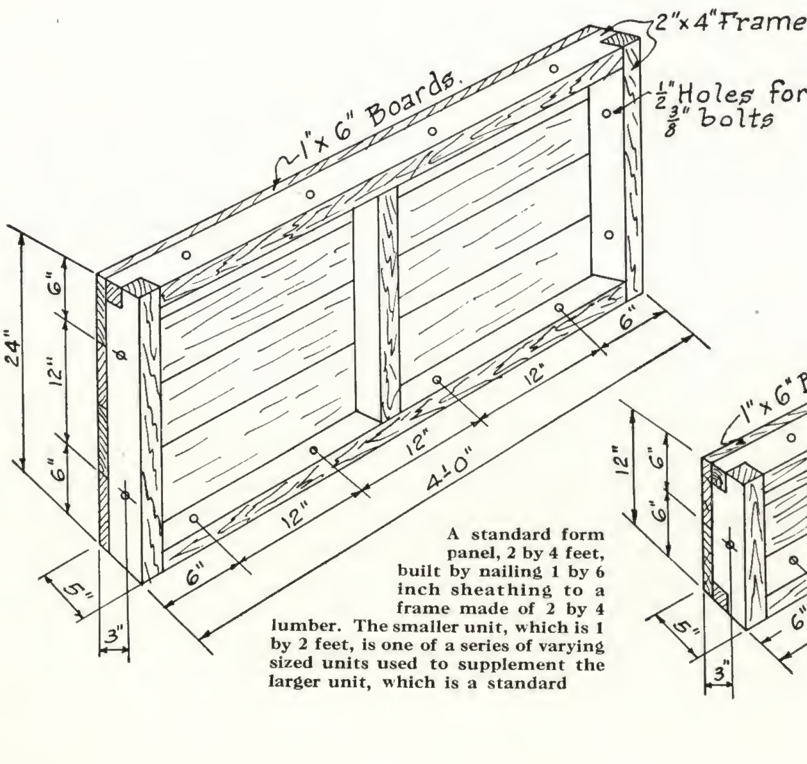
Since the greater portion of concrete work is seldom duplicated, most forms for concrete work are made of lumber. Forms can be made of any material that has a smooth surface to which concrete will not stick. Norway pine, hemlock, or other lumber of similar quality and grade is used for economy and because it is easy to work.

For work that is not to be exposed to view, such as an interior wall surface that ultimately is to be covered by sheathing and plaster, rough lumber can be used for the forms. Otherwise lumber dressed on one side, and preferably tongued and grooved, is recommended. For such concrete work as foundation walls below ground level, forms are unnecessary if the earth is firm enough to stand without caving. An exception to this is where the excavation is so deep that dumping concrete into the trench will break down the soil and mix it with the concrete.

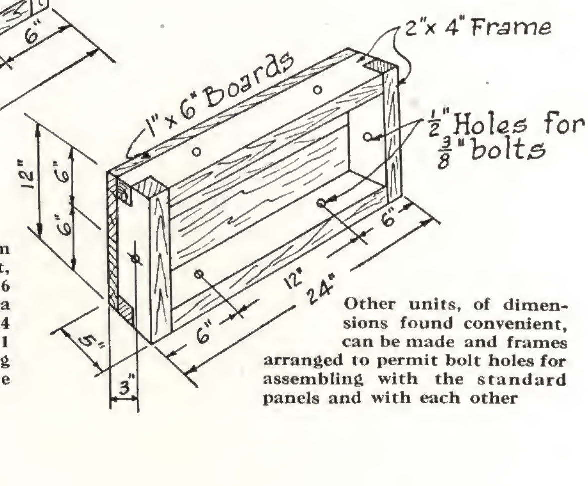
Good workmanship on forms is important because the appearance of the finished work is governed by the care with which forms are made and set up.

Considerable economy results from planning forms carefully before cutting lumber. Planning involves careful study of the working drawings of the structure or object to be built. It should be remembered that the inside surfaces of the forms lie against the concrete and thus reproduce the design, shape, or details intended. A projection designed on the structure calls for a depression in the face of the form to produce that projection. In other words, the form surface or interior face must be the reverse of the finished concrete surface or face.

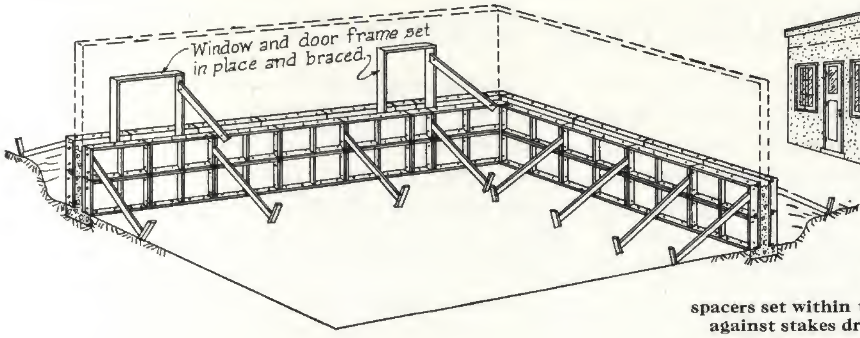
Forms can be made in standard size panels and used repeatedly. Panels 1 by 2 feet and 2 by 4 feet are convenient for small foundations and similar work. In some cases wooden forms are metal lined for the two-fold purpose of making them last longer and insuring a better surface of the finished concrete.

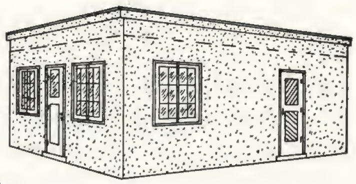


A standard form panel, 2 by 4 feet, built by nailing 1 by 6 inch sheathing to a frame made of 2 by 4 lumber. The smaller unit, which is 1 by 2 feet, is one of a series of varying sized units used to supplement the larger unit, which is a standard

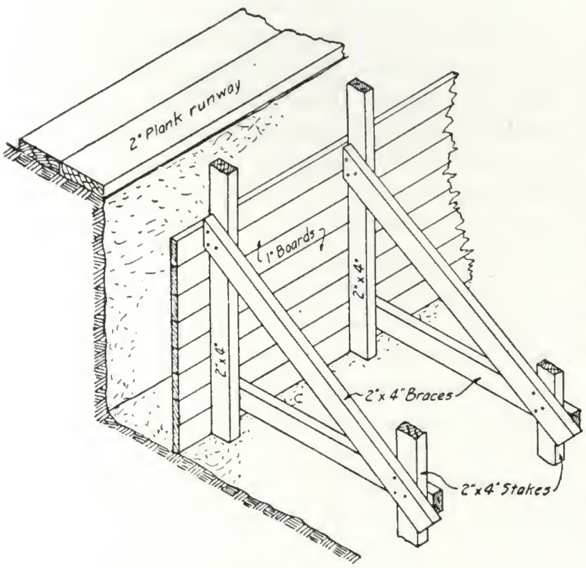


Other units, of dimensions found convenient, can be made and frames arranged to permit bolt holes for assembling with the standard panels and with each other





Assembled units set for concreting an ordinary wall. They may be held together and kept correctly spaced by wire ties pulling against spacers set within the forms and by braces resting against stakes driven in the ground as shown

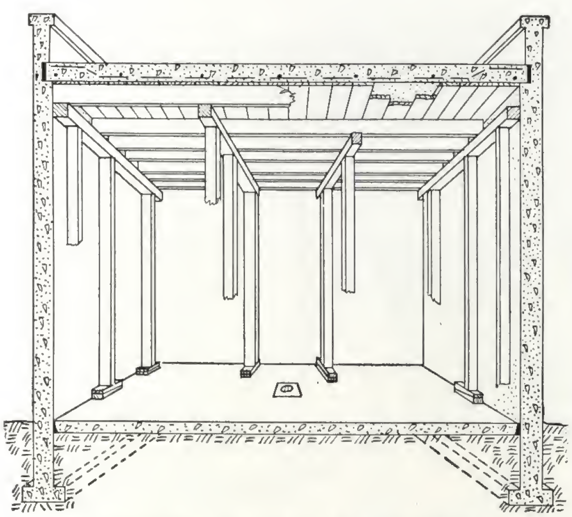


For silos, grain tanks, chimneys, and some other circular structures, as well as certain rectangular ones, metal forms have been devised. Such forms are in general use by silo builders and by building contractors specializing in concrete construction.

It is often possible to assemble pieces by using a few nails or screws, making it easy to take forms apart when the work has been finished. Wires, screws, bolts, and improvised clamps are used to avoid nailing and to enable forms to be taken down without damage to green concrete.

It is customary to wet the forms during extremely dry weather before placing the concrete. This prevents the dry lumber from absorbing water from the concrete mixture, thereby depriving it of the moisture necessary for proper hardening.

To prevent concrete from sticking to small wooden molds, saturate them with a mixture of boiled linseed oil and kerosene. Oil drained from the crankcase of an automobile is also satisfactory for this purpose.



Forms used for the construction of a concrete roof should be supported by plenty of strong posts. The bottom of these posts should rest on double wedges, as shown above, to facilitate easy removal. Few nails should be used

Removal of Forms

Forms should be removed only when it is known that the concrete is strong enough. For some classes of work, such as ordinary walls for buildings only one story high, it may be possible to remove forms at the end of twenty-four or thirty-six hours, providing the concrete is to bear no load except its own weight. However, there is no invariable guide for form removal, and it is best to leave all forms in place a little longer than seems necessary. Particularly is this true in cold weather, because concrete then hardens very slowly.

All forms should be thoroughly cleaned after removal, so as to leave them in condition for next use.

Reinforcing Concrete

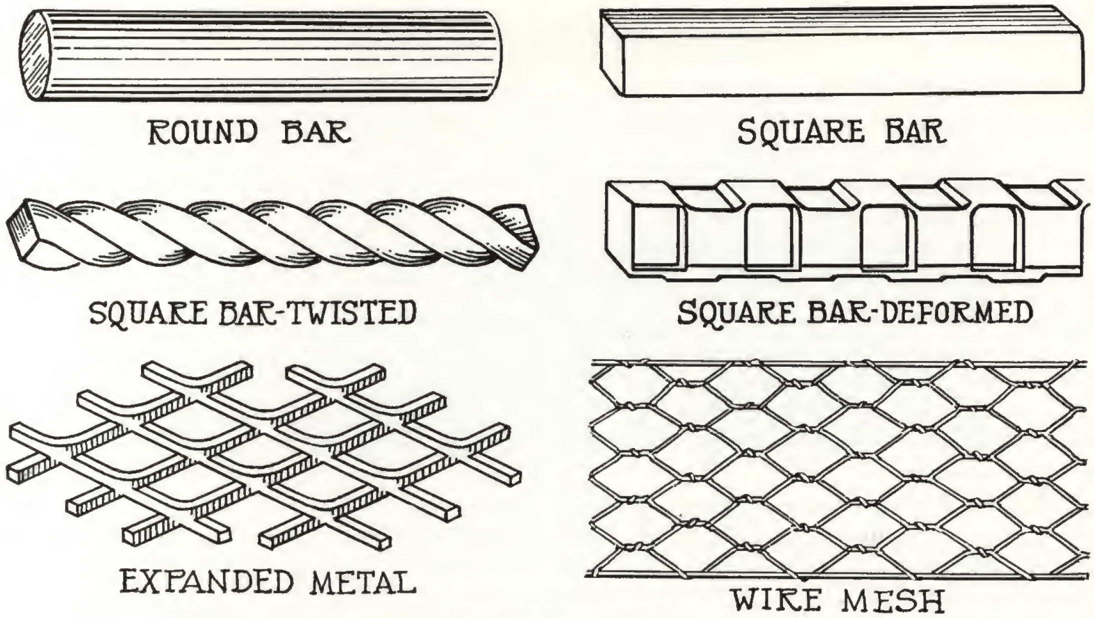
REINFORCEMENT is needed for concrete subjected to strains other than those of compression. The compressive strength of concrete is approximately ten times its tensile strength. Reinforcing metal of suitable size and shape, properly imbedded in the concrete, will provide the necessary tensile strength for beams, overhead floors, walls, tanks, silos, or any other structures which carry loads. Concrete properly mixed and well placed adheres to steel and forms a firm bond. When loads are applied, the steel immediately takes its share of the strain. Reinforcing may be in the form of round, square, or deformed steel bars, or various kinds of expanded metal or wire mesh. The object of deforming the bars, either by lugs or depressions in the surface, is for the purpose of increasing the "mechanical bond" between the concrete and the steel.

Reinforcing must be free from rust, grease or any other foreign substance that would prevent the concrete from adhering to it. All rust in the form of dust, and particularly scale, should be removed with a wire brush. The bending of reinforcement should be done gradually, in order that its strength will not be impaired by small fractures. The substitution of barbed wire, fencing fabric, chain, pipe and scrap metal for reinforcing steel will not provide the necessary strength for satisfactory concrete work. Good reinforcing steel, whether in the form of rods, mesh, or fabric, must have a certain chemical composition giving it a definite strength. Rods obtained from the local blacksmith's shop, or ordinary fencing fabric, will not answer the purpose.

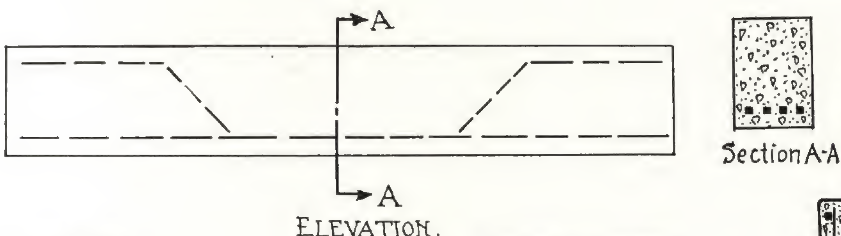
To give the desired strength, reinforcement should be placed in exactly the position called for by the plans. The ends of mesh should be overlapped 4 inches or more and bound together securely by wire so as to prevent displacement during placing of concrete. Rods should be lapped from 50 to 60 times their diameter. They should have their lapped ends separated enough to permit surrounding all parts of the metal with concrete and thus produce a perfect bond.

Steel is used instead of other metal for reinforcing concrete because it has practically the same ratio of expansion as concrete. In other words, all substances expand and contract under changing temperature conditions and the rate of expansion in steel and concrete is so nearly the same that the bond between the concrete and steel is not broken.

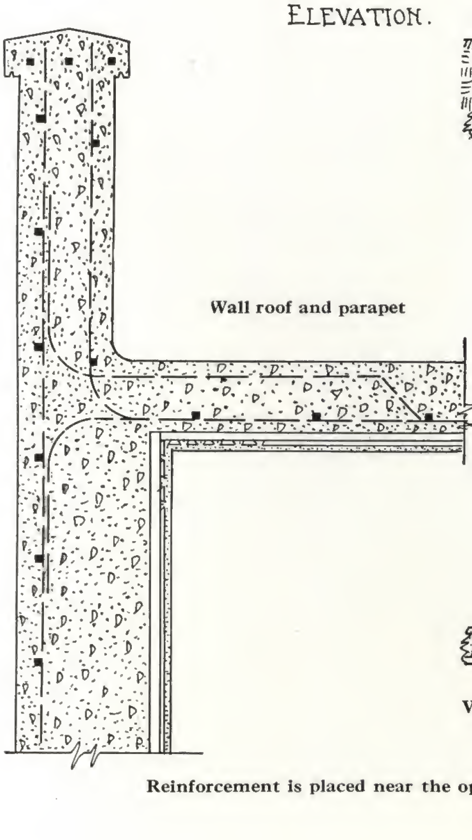
In reinforced concrete the rods are placed in certain positions so that the steel thus imbedded will take the tension and safely carry the load



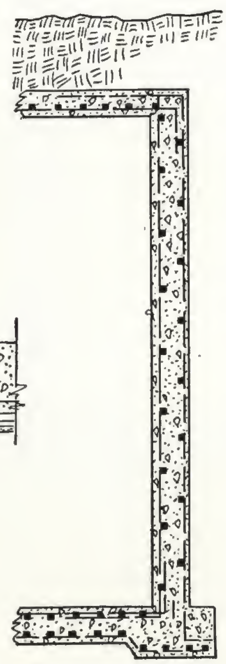
Reinforcing materials



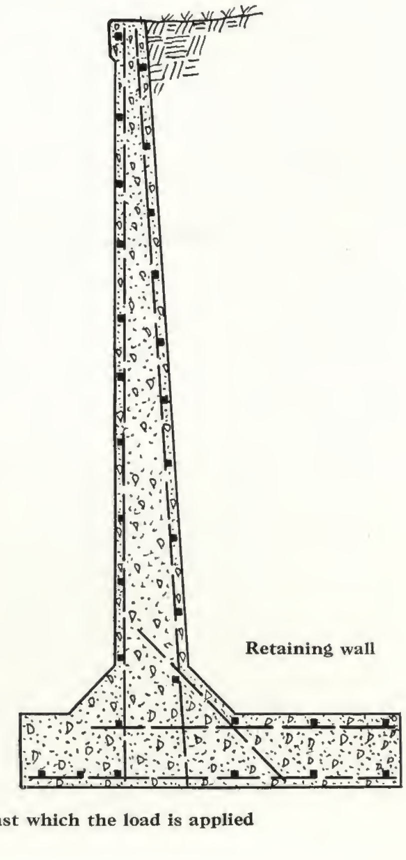
Concrete beam supported on both ends. Rods placed along bottom, where tensile strength is required. Alternate rods bent up as some pull occurs at the top, near supporting points



Wall roof and parapet



Vertical section through underground cistern



Retaining wall

Reinforcement is placed near the opposite face to that against which the load is applied

Proportioning Concrete

CONCRETE mixtures are specified as 1 : 2 : 3, etc. These figures represent the volume of each of the three materials used, always in the following order—cement, sand and stone. Thus, a 1 : 2 : 3 mixture would be one bag of cement (which contains 1 cubic foot), 2 cubic feet of sand, and 3 cubic feet of gravel or stone.

A mixture of 1 : 1½ : 3 gives a very dense, strong, and waterproof concrete. It is, therefore, suitable for cisterns and tanks, and for work subjected to unusual stress, wear, or moisture exposure.

A 1 : 2 : 4 mixture is probably an average mix, and produces concrete of quite high strength and water-proofness. It is used in columns, beams, fence-posts, sidewalks, retaining walls, and foundation walls.

The 1 : 2½ : 4 mix is used for feeding floors, walls of 6-inch thickness or less, culverts, and work needing concrete of ordinary strength.

A mix of 1 : 2½ : 5 is suitable for footings and walls thicker than 6 inches. Any mix in which the cement proportion is lower than this can be used only where mass and not strength or watertightness is required.

Volume of Concrete from Various Mixtures Made in Batches, each Containing One Sack of Cement

Mix	Cement	Sand	Pebbles or Stone	Volume of Concrete
Cement, sand and pebbles in order given	Sacks	Cubic feet	Cubic feet	Cubic feet
1 : 1½ : 3	1	1½	3	3½
1 : 2 : 4	1	2	4	4½
1 : 2½ : 4	1	2½	4	4⅘
1 : 2½ : 5	1	2½	5	5⅔

TABLE OF RECOMMENDED MIXTURES AND MAXIMUM SIZES OF GRAVEL AND STONE

	Maximum Size of Gravel and Stone in Inches
1:1:1½ Mixture for	
The wearing course of two-course pavements	¾
1:2:3 Mixture for	
Reinforced concrete roof slabs	1
One-course concrete roads and pavements	3
One-course walks	1½
One-course concrete floors	1½
Fence posts	½
Watering troughs and tanks	1
Construction subjected to water pressure, such as reservoirs, storage tanks, cisterns, dipping vats, etc.	1
Manure pit cisterns	1
Well linings	1
Corn crib floors	1½
Hog house floors and foundations	1½
Hog wallows	1
Stable and barn floors	1½
Watertight walls for extreme conditions	1
Sidewalks and pavements	1½
Dairy house floors	1½
Walls of pits or basements exposed to moisture	1½
1:2:4 Mixture for	
Reinforced concrete walls, floors, beams, columns, and other concrete members designed in combination with steel reinforcing	1
Foundations for engines subjected to heavy loading, impact, and vibration	2
Steps and stairways	1
Well covers, reinforced	¾
One-course feeding floors	1½
One-course barnyard pavements	1½
Smokehouses	1
Septic tanks	1½
Watertight walls	1½
Walls above ground	1½
Sidewalks and pavements	1½
1:2½:4 Mixture for	
Silo walls, grain-bins, elevators, and similar structures	1½
Building walls above foundation, when stucco finish will not be applied	1½
Base of two-course roads	2
Base course for foundations and two-course floors of poultry houses	1½
Watertight walls	1½
Walls above ground	1½
1:2½:5 Mixture for	
Walls above ground which are to have stucco finish	1½
Base of two-course walks, feeding floors, pavements, and floors	1½
Culverts, dams, small retaining walls	2
Basement walls and foundations where watertightness is not essential	2
Foundations for small engines	2
Manure pit floors and walls	1½
Hotbeds and cold frames	1
1:3:6 Mixture for	
Mass concrete—large retaining walls, heavy foundations, and footings	3

Mixing Concrete

IF concrete is to be mixed by hand, a watertight mixing platform is needed, about 8 by 10 feet, large enough for two men to work upon at one time. It can be made of 1- or 1¼-inch surfaced lumber, tongued and grooved, and free from knots. Tight joints are necessary to prevent the loss of cement when water is added. A strip around the edge about 2 inches high will prevent loss of materials.

A measuring box 12 by 12 by 12 inches (inside measurements), without a bottom, will hold one cubic foot, and is a convenience in measuring sand and stone. The cement need not be measured, as each sack contains one cubic foot. Measure sufficient sand for one batch and spread over the board to a depth of 3 or 4 inches. Then spread the cement as evenly as possible over the sand, and turn over both cement and sand with a shovel until all streaks of brown and gray disappear and the color is uniform. Next thoroughly wet the pebbles or broken stone, measure the desired quantity and spread in a layer on top of the cement and sand. Mix all the materials thoroughly by turning several times with a shovel. Make a hollow in the center of the pile and add water while mixing, until the desired consistency is obtained.

Avoid using too much water in mixing. Excess water weakens concrete. The proposed use of the concrete will determine the amount of water necessary.

A moderately wet mix, just wet enough to run off a shovel or pour from a wheelbarrow or bucket, is best for pouring into forms and for reinforced concrete work in which the steel must be perfectly imbedded.

A quaking or jelly-like mix (one that trembles when spaded) is required for floors, driveways, and pavements. The quaky mix is preferable wherever it can be used.

Drier mixtures than the quaking consistency are frequently used in curbing, gutters, bases for two-course pavements, etc., but they are not recommended. The concrete should always be wet enough to bring water to the surface with moderate spading.

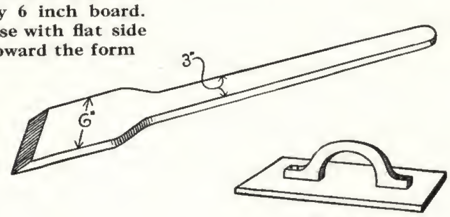
Thorough mixing increases the strength of concrete, and a small power-operated mixer will reduce labor cost and give better concrete.

Placing Concrete

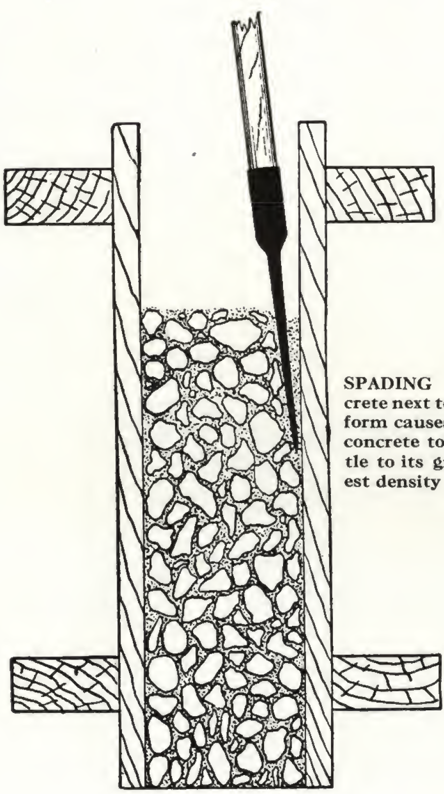
CONCRETE commences to harden very shortly after the water is added, and should be placed in the forms as soon after mixing as possible, in order that it may assume the shape intended. It is convenient to have the mixing operation carried on near the place where the concrete is to be deposited.

When concrete is being placed in an excavation for a foundation wall, place boards or planks along and across the trench so that workmen wheeling barrows loaded with concrete can dump the concrete without breaking down the trench sides. Concrete should be deposited in layers of uniform thickness throughout the enclosure made by the forms. From 6 to 8 inches is the greatest depth that should be placed at one time, because a layer of greater thickness cannot be compacted by spading or tamping.

SPADER
Made of a 1 inch by 6 inch board. Use with flat side toward the form



FLOAT
For producing a rough sand finish on concrete surfaces



SPADING concrete next to the form causes the concrete to settle to its greatest density

Concrete placed in forms should be consolidated by spading. This settles it to utmost density; causes it to thoroughly surround and adhere to the reinforcement; and releases air-bubbles that may be entrapped in the concrete. Spading concrete next to form faces is very important. The particles of coarse gravel or stone are forced back from contact with the form, allowing a film of sand-cement mortar to settle next to the face of the form, producing a dense, even surface. When a dry concrete mixture is used, it should be compacted by vigorous tamping as soon as the concrete has been placed.

When concreting troughs, watering tanks, silos, and other structures which should be both air- and water-tight, concreting should be carried on as continuously as possible in order to eliminate construction seams. Many jobs cannot be completed within a working day. Work stopped for the day must be left in such condition as to make it easy to resume later without leaving a poor bond or the effect of a seam. This is usually done by roughening the concrete in the form when work is stopped; then immediately before resuming work painting the old surface with a paint made of cement and water, mixed like thick cream, and applied with a broom or swab. Immediately following this, place the concrete in the regular way.

Between narrow forms concrete has to be placed in thin layers because of the difficulty of spading in the narrow space. Under such conditions only one side of the form should be boarded up to full height, leaving the other side to be boarded as concreting progresses.

Precautions must be taken not to allow concrete to drop from too great a height when placing. From 6 to 8 feet is the maximum distance. If allowed to fall a greater distance, there will be some separation of the materials, with the result that the finished work will show pebble pockets on the surface.

Curing Concrete

THE hardening of concrete is not a drying process. It is the combination of water with cement which causes concrete to harden. Forms are often taken down and the work exposed to wind and sun in the belief that such treatment is an aid to thorough hardening. This practice deprives the concrete of a great deal of added strength that proper protection would have given it. Exposure to drying influences weakens concrete structurally, and deprives concrete floors, walks, and other work of strength that would increase wear resistance. Keeping concrete damp the first ten days will give 65 per cent. increased strength and hardness. Three weeks' protection will give a still greater increase.

The forms furnish a measure of protection to concrete walls above ground. The earth of a foundation trench in contact with the concrete provides all the protection the foundation needs while curing. Work above ground, however, should be wet down for several days by drenching it with water, in order to thoroughly harden the concrete. Floors, sidewalks, street and road pavements are protected by a layer of moist earth, sawdust, or other moisture-retaining material applied as soon as it can be placed without marring the surface of the concrete. The best method of protecting pavements and other flat surfaces is to place a small ridge of clay around the edge and flood with water.

Walls can be covered with canvas or burlap and sprinkled with water several times a day.

During moderate weather, where floors are being laid indoors, the enclosure formed by the structure makes extreme measures of curing unnecessary. However, occasional sprinkling of the concrete surface for several days will increase its strength.

Curing is well repaid in the greater strength, durability, and wearing resistance of the concrete, particularly in the case of driveways, walks, and other work subjected to heavy travel.

Waterproofing Concrete

CONCRETE that is correctly proportioned, thoroughly mixed, properly placed, and well protected while curing will be watertight.

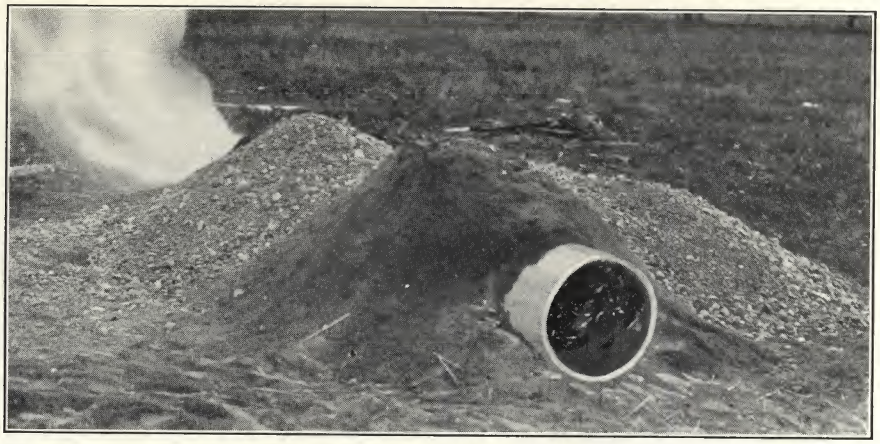
One of the oldest processes of waterproofing concrete consists of adding alum and soft-soap to the concrete when mixing, or applying separate solutions of these materials to the concrete surface after it is finished. The effectiveness is due to the fact that chemical compounds are formed which fill the pores of the concrete with an insoluble material.

Asphalt and coal-tar are sometimes used for waterproofing, particularly as applied to the outside of foundation or basement walls. They are applied hot with a mop. Several coats are usually given.

Failure to make some classes of construction waterproof can be remedied by various after-treatments. If leakage from a cistern or tank consists merely of slight seepage through the walls, a coat of cement mortar (sand and cement) may be applied to the interior of the tank. The surface must be thoroughly cleansed by scrubbing it with water and a good stiff wire-brush. If scrubbing will not clean the surface, then the cement film should be removed by applying a wash of one part muriatic acid to three or four parts of water, allowing this to remain for a very few moments and then *thoroughly* rinsing with clean water. Immediately before applying the plaster coat the cleansed surface should be painted with cement and water mixed to the consistency of cream. This can be applied with an ordinary brush and the plaster should be spread on immediately and worked in place vigorously before this wash has commenced to harden.

Plastering will not remedy cracking due to deficient and ineffective reinforcement. The only way to repair such a structure is to use the old tank as a form and build a new reinforced concrete lining within it.

Cracks in tanks or troughs can be repaired by cutting out each side of the crack to form a "V" shaped groove 1½ inches deep and about 1 inch wide at the surface. Calk this groove with oakum soaked in tar until half filled, and finish with a 1:2 cement mortar (one part of cement and two parts of sand).



Winter Concrete Work

CONCRETE construction work on the farm must necessarily be undertaken either in the spring or in the fall after harvesting, and at the latter period there is frequently a hesitation in attempting this work in anticipation of the approach of cold weather.

Fall concrete work can be readily undertaken without any anxiety that the work started during that period cannot be successfully completed, if proper precautions are applied, even though freezing weather overtakes you.

As cold weather has a tendency to retard the hardening of concrete, protection must be given to insure maximum strength through proper curing.

When the prevailing temperature is in the neighborhood of 38° F., the hardening of concrete is practically suspended. At 32° F. (the freezing point) it ceases entirely.

There is no change in the mixture or methods of placing concrete in winter. The difference lies in the preparation of the materials, such as heating the water, sand, and stone and in protecting the work until the concrete has hardened. Sand, pebbles, or broken stone are readily heated by stoves improvised from sections of an old steel smokestack, and water may be heated in any convenient receptacle.

Various methods are used to protect the concrete and to keep it as nearly 60° F. as possible, over a period of at least two days. At the end of this time hardening will have progressed far enough to render it proof against injury from freezing.

Coke-burning stoves will maintain the required temperature. Where the work is not enclosed, canvas or building paper fastened to frames or studding will provide the necessary housing.

Frozen concrete should not be mistaken for naturally hardened concrete. Forms should not be removed from concrete work done in cold weather until it is positively known that the concrete will be self-supporting or, if it is to carry loads other than its own weight, that it has acquired sufficient strength.

How to Place Concrete in Cold Weather

Heat sand and pebbles or broken stone and mixing water so that the concrete when placed will have a temperature of at least 80 degrees.

Place concrete in the forms immediately after mixing so that none of the heat will be lost.

Protect concrete immediately after placing to retain heat. Canvas covering, sheathing, housing the work, or a layer of straw will furnish protection for most work. Where the work can be enclosed, stoves may be used. In severe cold weather protection should be continued for at least five days.

Examine concrete before removing forms by pouring hot water on the concrete or warming it in some other way to see whether it has hardened or is merely frozen. If frozen, heat will soften the concrete by thawing the ice in it. Frozen concrete when struck by a hammer will often ring like properly hardened concrete, so you cannot rely on that test. Don't remove forms too soon in cold weather.

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